MARCH
1942

In this Issue
AMERICAN PLANES
IN THE R.A.F.
By J. J. Waddington

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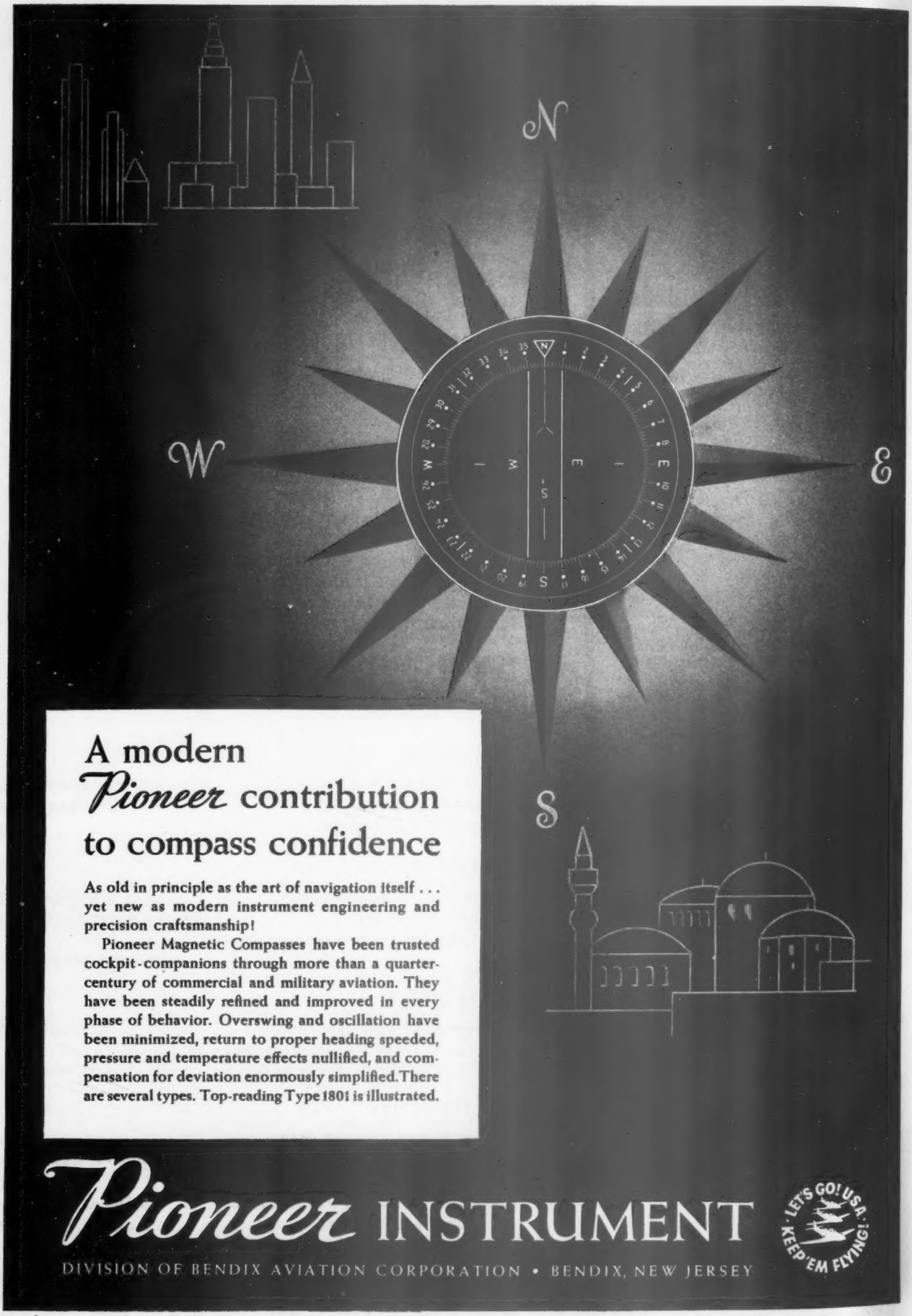

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WE TAKE CONGRESS to task editorially for injecting a regrettable political flavor into its investigations of aviation contracts, and urge that a more objective and constructive procedure, like that of the Harter report, be followed in the future if the best interests of the American people are to be served (page 51).

AVIATION's War Communique No. 3 again interprets the part played by air power in the progress of the war over the month (page 52). Some last-minute telegraphic communications from the War Department commending aircraft workers for their part in helping the armed forces win battles were incorporated in the body of the Communique on page 110.

U. S. PLANES AT WAR

The effectiveness and growing popularity of American flying equipment in combat service abroad is described in the article, American Airplanes Over European Battle Fronts by Myles V. Cave, our British correspondent (page 54).

Alaska, virtually the last frontier of the United States and its possessions, assumes a new strategic importance in the light of the spreading naval and aerial warfare in the Pacific area. Mr. Ramme's article (page 58) describes the advantages offered by air transportation in a sparsely settled region of difficult terrain and rich natural resources.

On pages 60 and 61 there are presented three-view silhouettes of 20 Japanese military aircraft types, along with photographs of several of their more widely used military and naval planes. It is anticipated that these will be useful for the purpose of training in the identification of foreign aircraft.

The manufacturing section of AVIATION, in keeping with its growing importance as a source of timely information for the industry in its superlative production effort, achieves in this issue the status of a separate section of the book. Beginning on page 63, the section is printed on a distinctively colored paper.

Charles C. Misfeldt, inventor and engineer, describes a process he developed for speeding up deep drawing of sheet metal parts on power presses which should prove of interest to nearly every plane production plant (page 64).

I. Ae. S. MEETS

For the many busy engineers who were unable to attend in person the sessions of the Tenth Annual Meeting of the Institute of the Aeronautical Sciences, our editors have digested the most significant papers, save for those restricted by the War Department, with the thought that the industry's design and production men would be able more quickly to determine which of these scientific studies would warrant a fuller investigation to assist them in the solution of their own problems. This feature (page 66) again includes a selection of pencil sketches of outstanding figures in the industry, ably executed by Mrs. E. P. Korn.

H. P. Reiber of Lycoming Division, Aviation Manufacturing Corp., gives a detailed description of the process developed in his organization for the quantity production of hollow steel propeller blades (page 68).

Geometric Airfoil Charts is the subject of an article submitted by Charles F. Marshner of McDonnell Aircraft Corp. He presents a suggested utilization of charts to save calculations.

The first of two articles on Charting Stability in Aircraft, by Cortlandt D. Perkins, begins on page 75. Harold Caminez describes the development and advantages of the new "Heli-Coil" Spark Plug Bushing (page 80).

The first of two articles on Synthetic Resins in Aircraft Construction by H. N. Haut of Bellanca begins on page 84.

How the R.A.F. has geared its maintenance and repair organization to war time operational requirements is described in an article by J. I. Waddington (page 122) which leads off the maintenance section.

LIGHT PLANES AT WAR

The military section includes a first hand report on the part which can be played by light airplanes in modern warfare as a result of experiments conducted in the recent large-scale army maneuvers in the southern states (page 138).

There are other informative articles in all of these departments plus the air transport and civilian flying sections, and all of the other regular departments such as AVIATION NEWS, the Radio Page, and Selig Altschul's analysis of aviation's constant adjustments (page 119).

Coming

The April issue will include an informative article on the coordination of propeller design with performance requirements by Harold H. Warden of the Curtiss-Wright Propeller Division; an article describing a method of formulating design charts for determining safe wall thicknesses of tubes subjected to bending, by Walter C. Clayton; a descriptive story on the precision machine operations involved in the manufacture of landing gear struts for the Lockheed P-38 Interceptor, by Wilbur G. Wood, chief engineer of Menasco Manufacturing Co., and a score of additional features covering all phases of the aviation industry's activities.

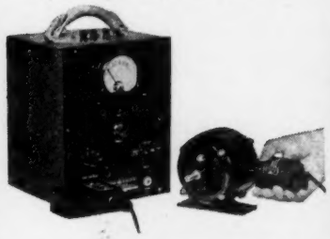
ALUMINUM CONSERVATION

In a forthcoming issue there will appear also an article on the all-important problems of conserving aluminum through reduction of scrap generated in the manufacture of aircraft. The story will include suggestions to assist in the solution of these problems.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

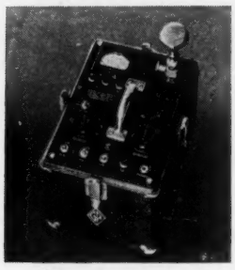
MRS. ALICE ROGERS HAGER'S informative analysis of the important role being played by Brazil in the rapid growth of air activity in South America is concluded in this issue (page 51). Mrs. Hager's recent book, "Wings Over the Americas" is based on the information she assembled on her tour of Latin America last summer. She was particularly impressed by the far-sighted concept of Brazil's military and governmental leaders of the future role to be played by aviation in the development of the vast untapped resources of the nation. The splendid photographs illustrating both installments of Mrs. Hager's story were the product of Miss Jackie Martin, who accompanied Mrs. Hager on the South American trip.

Among the many instruments needed for indicating, recording, and analyzing vibrations, movements, noises, and accelerations in aircraft, ships, equipment, and structures, the following are worthy of consideration:



VIBRATION MEASURING EQUIPMENT

Velocity unit, Amplifier-vibration Meter, and Integrating unit for indicating velocities and displacements. In conjunction with recorders, oscillographs, and analyzers, records of amplitudes, velocities, frequencies, and accelerations are obtained.



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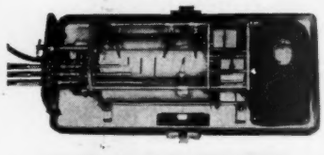

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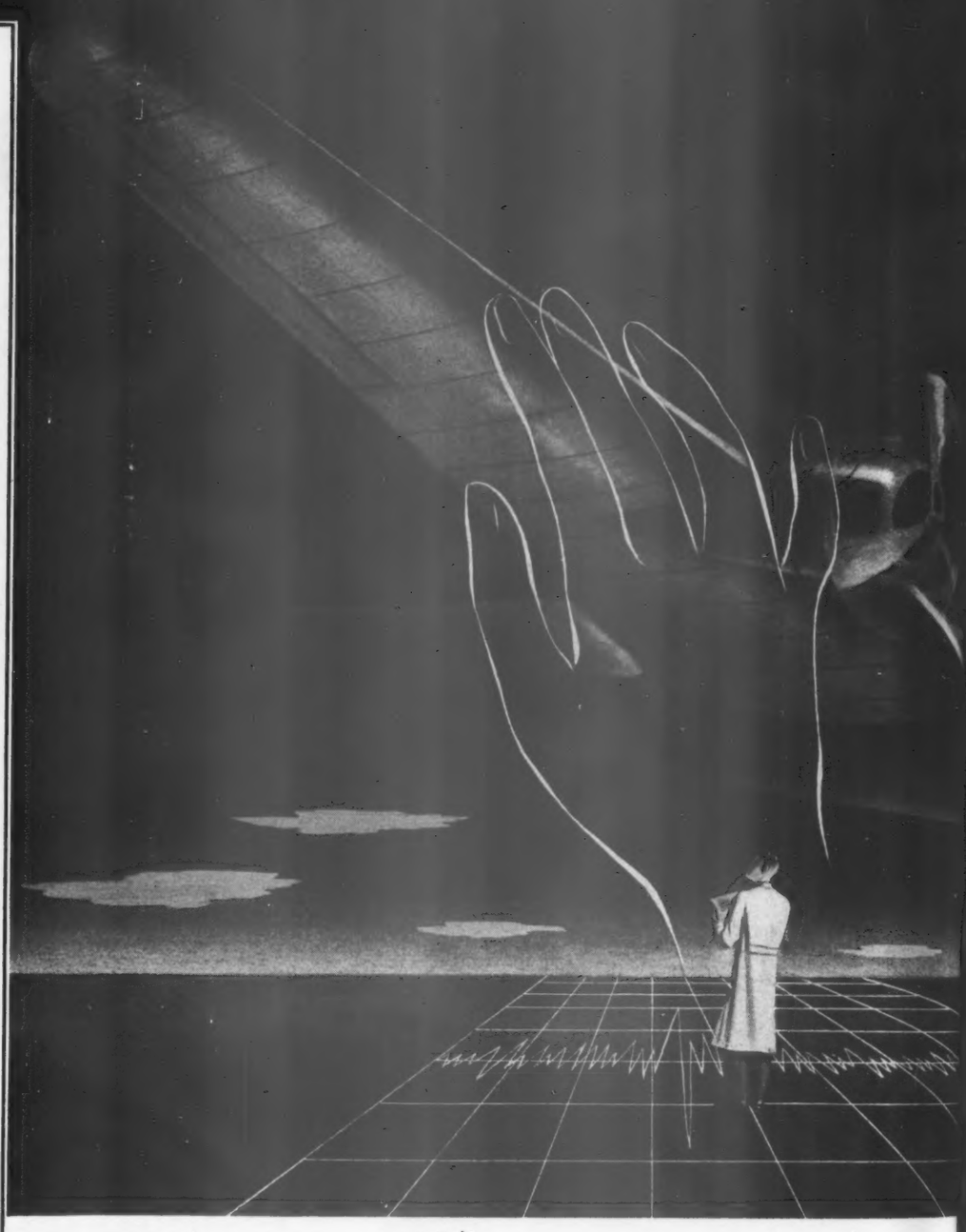

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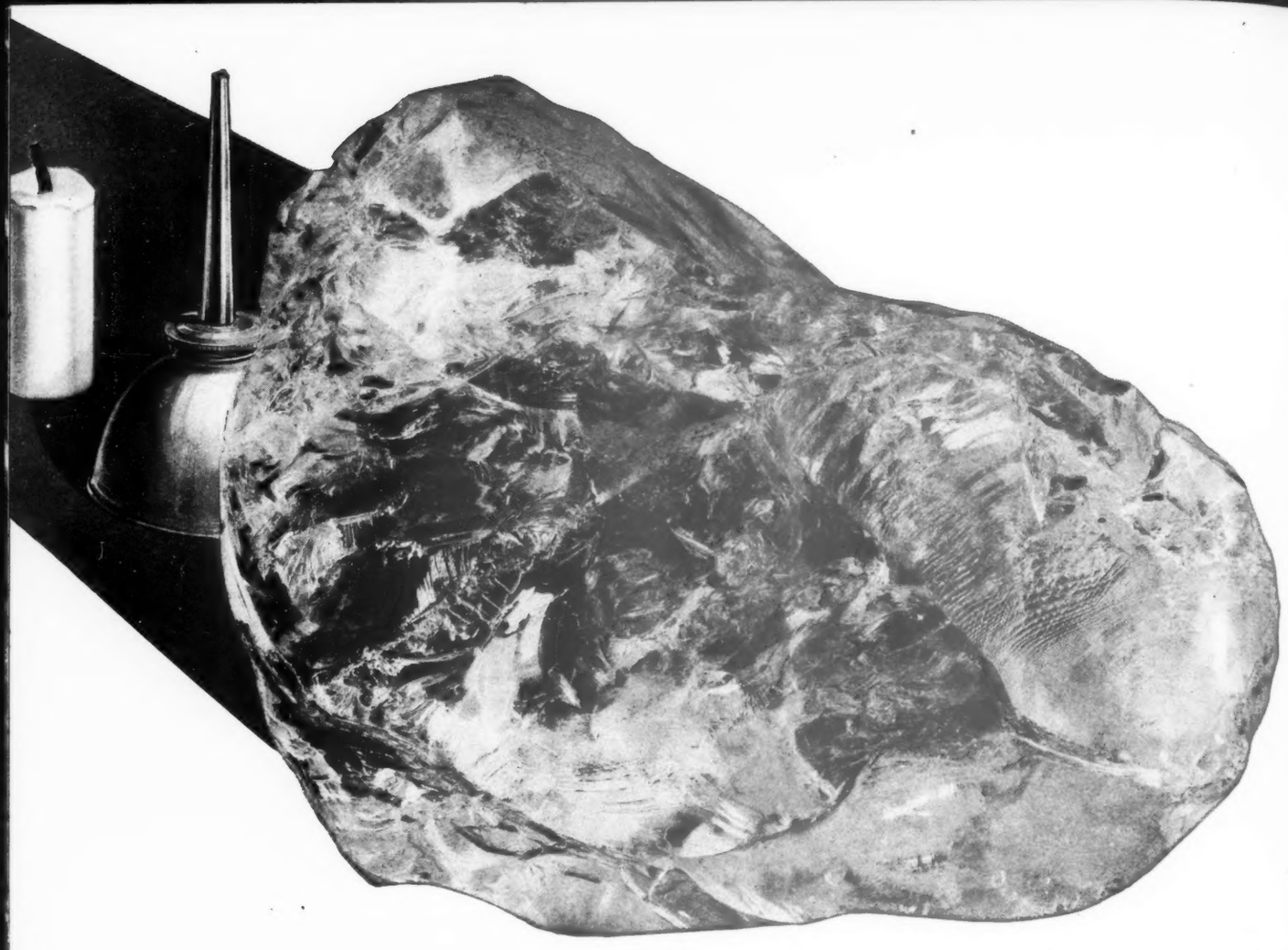

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"EVERY WEAPON *we make today is worth ten that we might produce next year; for this year – 1942 – is the critical year in the existence of the United States.*"

This grim challenge was thrown at American industry by Donald Nelson in his first speech as chief of the War Production Board. He was speaking to a group of business paper editors, called together to receive at first hand Mr. Nelson's urgent message to the industries they serve.

"We've wasted the golden months", he declared, "the months in which we could have expanded our steel industry, our chemical industry, our copper industry, and all the others, so that we would have plenty of everything. But we still have ten silver months – the months that remain in 1942–and in them we can do things that we never thought possible."

To that objective Mr. Nelson has dedicated his high talents and boundless energy. And to that task he asks American industry to apply the full measure of its resources and skill.

That challenge should be all that it takes to exact from industry the last ounce of its energies. For by now we all can see that in this war the American way of life is at stake. American industry is the essence of the American way of life. Neither can survive without the other. So, even if it had no better reason, industry must go all out to win this war as a measure of self-preservation. Here self-interest and patriotic duty are synonymous. American industry cannot afford to let America lose this war.

The 1942 job is crucial. If it is well done we have a chance to win. If it is badly done we cannot possibly win. There is the measure of the responsibility that now rests upon the shoulders of industrial management.

It is not just Donald Nelson who asks this of industry. He speaks for the millions of fighting men – on land, at sea, in the air – the world over, whose eyes turn so desperately to the workshops of America. There and there alone can they see the hope of victory.

The people of America are not going to let those men down. They demand of industry every effort and every sacrifice that may be necessary to back them up. On that score, American industry stands, of necessity, on trial before our people. It must come through – or else!

* * *

As industry goes all out to meet this demand, its management asks of those who set its tasks and supervise its performance the utmost possible cooperation. It asks of them specifically an understanding of its problems and a chance to work them out without unnecessary interference. It asks for protection against attack from the rear while it concentrates its energies against the common foe. It asks a truce on economic reforms and social experiments that have nothing to do with winning the war and that are bound to arouse misgiving and mistrust amongst the proprietors of industry. Above all, it asks that it be not made a political scapegoat for every deficiency that is sure to develop in the confusion of a war effort.

This does not mean that industry resents honest criticism or constructive direction. Neither does it mean that it is unwilling to do its best unless it can have its own way in all things. The managers of industry are practical men. They know better than anyone else that unprecedented conditions call for new methods, that they must be open-minded to every criticism sincerely directed toward winning the victory. They know that no one can afford to be smug in the face of a national crisis.

There would be no point to my rehearsing here the pros and cons of such criticisms. Time is too short for that. Only in its performance can industry write a convincing answer to its critics. But as a help toward the achievement of that performance, I should like to clear up, if I can, one prolific source of misunderstanding and mistrust.

I refer to the solicitude of industrial managers as to where their companies may find themselves after the war. *This concern for the future sometimes is misinterpreted to mean that management is blind to the urgency of the present. But it does not mean that. It is a perfectly natural anxiety that must be felt by any responsible management operating under the American enterprise system – which is one of the things we are fighting to preserve.*

Under our system, the managers of industry cannot but feel a sense of responsibility to its owners, not merely for current dividends on their investments but also for the conservation of their properties. That means they must feel some concern over what may happen after the war to a business that now must go all out to help win the war. And their concern is but part of a general concern over what may be the effect of the war on the whole American way of life, preservation of which is our reason for being at war.

To give practical effect to that concern under present conditions is one of the problems of management. It is not an insuperable problem. Competent management will be able to surmount it, I am sure. But the right kind of help from those in authority can make the job a lot easier. And let us note in passing that the problem cannot be written off, as some critics of business seem to think, merely by setting off against it the profits that business can make on war contracts. That misses the whole point.

For a business enterprise is not, as many seem to think, just a "profit-machine." It is not set up and operated by its owners and managers for the sake of this month's or this year's profits, without regard to any other consideration.

The fact is that any worth-while business must operate as a going concern. It consists not only of stockholders and managers, but also of employees, markets, distributors, and dealers. Mostly, I might say, of markets, distributors, and dealers. They are the "reason for being" of any business, the source of its payrolls and its profits.

No competent management wants to scrap such essential elements of its business just for the sake of war-bred profits, however large they might look . . . at the moment. Most of the original reluctance to get into arms production, for which industry has been criticized, was not due to a "greed for profits", as has been charged. Rather did it arise from management's mistrust of "war profits" that can be made only by sacrificing the essential elements of a healthy business.

* * *

But now industry faces a dire national emergency. The survival of our country and all its institutions – including American business–is at stake. So management must shape its course to meet without stint every need of the war

effort. That means it must subordinate to that effort every other concern. To lose the war is to lose all. We must first win the war if we would save anything.

To the men of management that presents a grave responsibility. It is fair to ask whether government can do anything to help them meet it. One simple thing I think government can and should do. It cannot dissolve all the concerns of management, but it can help substantially.

Government should do all it can to help management conserve those assets of business that will contribute to post-war reconstruction, when that can be done without prejudice to getting on with the war.

Let me explain. Broadly speaking, every business comprises three elements. One is its tangible assets — its factories, machinery, equipment, and materials. Another is its productive capacity — its management, organization, trained working force. A third is its intangible assets — the goodwill, familiarity, acceptance, and recognition that it enjoys amongst its dealers, customers, and prospective customers.

When the nation goes to war government becomes the one dominant customer of a business. Of these three elements, the first two — plant facilities and organization — become of paramount importance to the job in hand. But so far as the government buyer is concerned, the third drops to minor importance.

But that third element cannot be ignored by the managers responsible for that business. For it will be their mainstay when they must rebuild that business after the war, when government has lost all interest in its existence, except as a source of tax revenue. That is why government can help greatly if now, during the war, it recognizes the legitimate concern of management to conserve those assets that will be essential to survival after the war.

Everyone recognizes the obligation of government to demand that the individual business go all out for war production, to forbid the production of goods not essential to wage war and to commandeer those that are, to require that a business sacrifice its markets and disrupt its distribution organization. No one questions the right of government to restrict arbitrarily the amount of earnings that a business may retain as profit from its war activities. In short, no one questions the right of government to become the dominant partner in any business that may be needed to win the war and, as dominant partner, to put the national need above any conflicting interest of the business.

But, as it does all this, government should remember that the survival of that business is staked on the public's knowledge and use of those discontinued or commandeered products, on the stability of that crippled dealer organization, on the ability of the business to maintain its standing in a market-place from which, temporarily, it may be barred.

And government can help management to deal with the exacting task it now faces, if it will do all it can to avert the needless sacrifice of business interests that do not conflict with war needs, if it will but remember that one of these days, that business again will be on its own, gathering up whatever resources it may have left, recreating its markets, rebuilding its distribution channels, reestablishing itself as a going concern . . . and doing all this in a competitive world without benefit of war orders.

The only foundation upon which any business can hope to rebuild when that day comes is its customers' memory of its name and their understanding of its products. Whatever credit may be coming to it for its war effort will not avail it very much if it permits itself to be forgotten. Its chief assets in that day will be the identity, recognition, and acceptance it still enjoys amongst those to whom it must look for business.

That is why so many business men, already going all out on their war jobs, become apprehensive whenever some word or act of a legislator or government official seems to question the validity of their sales, promotion, and advertising activities during the war. For they know that it is by such measures alone that any management can hope to conserve — while its business goes to war — the values it will need when it returns to civilian service.

That is why I ask government to do all it can to allay such uncertainties, to reassure business of its desire to help conserve those intangible assets that mean so much to business security. For that, I believe, will strengthen the hand of management in a big way as it goes all out on the vital job Donald Nelson has staked out for industry.

* * *

He has told us that if we are to make these ten silver months productive enough to make up for the golden months that are gone, industry must do things it never thought it could do. That is dead right. For America now finds itself in a position it never thought it could be in.

All too slowly, but very surely, it is dawning upon us that this is OUR WAR. Moreover it was our war long before we knew it or did much about it. So our job today is not merely to match the current production of our enemies. That is not enough. We must produce also enough to match the surplus of resources they had built up before we got started. We must produce enough not only for our own needs, but also for all the United Nations.

Moreover we must produce all that we need for *decisive* victory, for anything short of that will mean defeat. If we would save the American way of life, we must destroy once and for all the forces that threaten it. A stalemate would mean but an armed truce and what that might do to the American way of life and to American industry no one dares to guess. Victory must mean *decisive* victory. And this, very definitely is our war.

And just as definitely, this is OUR YEAR. For in this year — 1942 — we must prevent our enemies from achieving an advantage that might put victory forever beyond our reach — despite all our vast resources. It is an appalling fact that victory may slip beyond our grasp — not in 1943 or in 1944 — but during the months just ahead of us.

"Industry's responsibility in all of this is great," says Donald Nelson. "The job will take brains and initiative, but we can do it if we go out with a will."

To Mr. Nelson, that initiative means that industry must lead rather than follow in the march to more intensive use of our machines and our man-power. We dare not wait for new facilities to meet our mounting needs. More and more we must press for more widespread subcontracting and conversion. And he is counting on that initiative, backed by ever more aggressive effort, to avert or to minimize the compulsory measures that now seem imminent.

"We must stop thinking about what we're going to do to the enemy in 1943 and start thinking of what we're going to do to him in March of 1942. We must make today the things we would be making next year . . . if we had the time to spare."

That, says Donald Nelson, is the task of American industry during the next "Ten Silver Months." And to that gigantic task American industry now must bend every ounce of its abundant strength.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

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EDITORIAL

We Could Lose This War

NOW we know that the armchair strategists who boasted that we could lick the Japs in six weeks were wrong. So were the military leaders who glibly used the word "impregnable" to sell their constituents the Maginot Line and Singapore. The taxpayers' money wasted on these two projects would have built and tooled-up enough factories for a productive capacity of nearly 100,000 planes per year. The fall of Singapore is serious and will have far-reaching consequences. But much more important is the strategic concept of impregnability which has been blasted by the rapid liquidation of one of the world's most powerful fortresses. It is taking too many people too long to learn the simple truth that it is easier to shoot down than to shoot up.

For years the people of France lived in a false sense of security behind the Maginot Line. For more than a century the British people have counted upon Singapore to control the far eastern seaways. For centuries Americans have nestled snugly and complacently between the broad ramparts of the Atlantic and Pacific Oceans. And now, with German submarines to the east of us and Japanese submarines to the west of us, and the prospect of certain forms of aerial action against our coasts a very real one, many of us remain unmoved. How long is it going to take for us to learn that there is no such thing as impregnability?

In spite of the overwhelming evidence of the value of air power in modern three-dimensional warfare, it was a civilian business man named Donald Nelson who over-ruled the Army and Navy Munitions Board to provide A-1-a priorities for materials to build the combat aircraft that beleagured fighting forces are begging for. Before Mr. Nelson exercised his powers so wisely, the long-range bombers and fighter aircraft so sorely needed were lower on the priority list than battleships and tanks, neither of which are capable of effective action without air protection and support. Mr. Nelson deserves the highest commendation for his action and it is hoped he will continue to discharge his great responsibility with comparable competence and common sense.

While some of our military leaders are insisting on fighting this war like the last, certain elements in Congress are contributing to slowed up production by undermining worker morale in the aircraft industry. No worker can be expected to put forth his best efforts if he is told that the products he is building are obsolete and that defense manufacturers are making huge profits on contracts. If these public statements were based on an unbiased appraisal of the industrial war effort, they should be aired at any cost. But when the utterances of a high Air Force Officer are deliberately distorted for publicity purposes and when a couple of freak contracts are carefully singled out to make people believe that all manufacturers are thieves, it is time to pension a few congressmen to make room for others who do not thrive on publicity stunts in wartime. Even if our aircraft manufacturers were profiteers, and the excess profits tax takes good care that they are not, it might be preferable to pay them a little extra now rather than to pay eternal tribute to Hitler and Hirohito.

Fortunately there are Congressional committees which are striving to do a constructive job. Such a committee is headed by Representative Dow Harter (D. Ohio) whose recent report is a competent job and is highly recommended for those who want to know the truth about our air power.

With Congress trying to superimpose profit limitation upon excess profit taxation, some manufacturers are naturally concerned about stockholders. This would be commendable if we were not fighting for our lives. But stock interests won't be worth very much if their holders are forced to buy them over again with marks or yen.

Work stoppages through strikes continue in spite of Pearl Harbor, Manila and Singapore. Some workers are still more concerned with the amounts in their weekly pay envelopes than with the number of units they turn out. Even our lowest wage scale is superior to one that would enable the worker to buy nothing but a couple of bowls of rice a day.

This is no time to mince words. Unless our strategists get over the 1914-18 complex, unless Congress stops using aviation for a political football, unless management stops worrying about stockholders and workers stop striking, we are *not* going to win this war. Let's stop for a minute in this mad rush for personal gain and try to visualize our country in the same situation as that of occupied France. Conditions in occupied America would be the same but for one factor. France has some hope of deliverance.

Jesse E. Neville

AVIATION'S WAR COMMUNIQUE NO. 3

International

A Douglas SBD-1 Scout Bomber flying on anti-submarine patrol over the Pacific. Below is one of our eleven carriers. Navy has censored bomb racks and identification marks on plane and carrier.

JAPAN'S WARPLANES have turned out better than the public thought they would, and somewhat better than Allied airmen expected. Most of the enemy's aircraft types have been made public now, in a bits-and-pieces manner that leads one to suppose our intelligence services only recently got the information together.

Though Japan still has the upper hand in the air in nearly all war areas, her superiority is plainly in numbers rather than in performance. There appears to be no record of an English or American or Dutch defeat, against any odds.

Japanese planes look good, but evidence increases that they are all copies, meticulously and skillfully lifted from American, British and German designs. Like copies in other arts and crafts they do not breathe the breath of life.

There is no further evidence that Nippon has any Messerschmitts, either 109's or 110's, or any four-engined Focke-Wulfs, as earlier reported. If they do have any, they are very few.

If the enemy had any outstanding performers, they would soon be heard from, as the Spitfires and the P-40 Tomahawks have made their mark. Until this happens, one must assume their models are all mediocre.

They have no engines of their own apparently. Air cooling dominates their power plants, all exactly copied after our own, particularly Pratt & Whitney, which was built under license. Licensing of this engine did no harm, since they would have copied it anyway. They also build Rolls-Royce and Fiat engines.

A full line of types make up the Japanese air force: heavy, medium and dive bombers; a couple of good fighters (land and ship based); torpedo planes, and several kinds of trainers and transports. Thus far the Japanese have done their best work in dive bombing. There has been no official confirmation of any successes at level bombing.

Japan has from 15 to 20 aircraft factories scattered throughout the country and the location of most of them is known to the British and Americans as a matter of course. Not much is known about their methods of manufacture.

AVIATION's early estimate that the Japanese had about 6,000 airplanes, total in the Army and Navy, and a production rate of between 300 and 500 per month, still seems to hold good. It is believed that their production rate when they started the war will not be increased, due to scarcity of materials, limited plant capacity and lack of manpower to spare. The rate might even decline. Neither one of Japan's allies can spare any planes, even if they could be delivered.

So far, predictions of air war in the East from air carriers have not panned out. There are no reports of United States

carriers being in action, and only two or three times have Jap carriers been in evidence—once at least in the battle of Macassar Strait.

Carriers are thin-skinned, and neither side seems willing to risk such a large investment in ships, men and planes. It is assumed that American carriers, of which we have eleven, berthing about 80 planes each, will go into action when the Navy has built up enough superiority in destroyers to protect them.

We are fighting a war, not in two oceans but in several, with a one-ocean navy. It was the grand strategy of the Axis to make us do just that, and it may work a hardship on us till we can get nearer our goal of 4,000 ships of all kinds, including 32 battleships, 18 carriers, 91 cruisers and 364 destroyers.

Meanwhile we are pushing our four-engined bomber program, ten to one over recent plans. Allied strategists have great faith that these bombers will play a major role in the defeat of the Axis both in the East and in the West. The Japanese are spreading themselves all over a thousand islands in the Southwest Pacific, and their supply lines will be in a bad way as soon as long-range bombers and ships can be brought to bear on them in sufficient numbers.

The battleship controversy still rages, with some pro-air power men demanding that construction on new ships, not more than a year along, be stopped. It is now public information that no battleships are included in the recent authorization of 150,000 additional tons of Navy shipping. But what the Navy, and Congressional Naval Affairs Committeemen are actually thinking about this large problem—the Mikado and Adolf Shicklegruber would like to know.

Glamour sometimes gets people into trouble; aviation has it, and should beware, in the opinion of many persons who take an over-all view of the war. One of these persons is William L. Batt, head of the Materials Division of WPB. Mr. Batt says that we had better not give all of our attention to headlines about three or four airplanes being shot down here and there; we should watch also the tremendous land power of the Japanese and the Germans, which is probably as strong as ever and may get stronger as it moves toward vital spots in the United Nations setup. Almost anyone will agree

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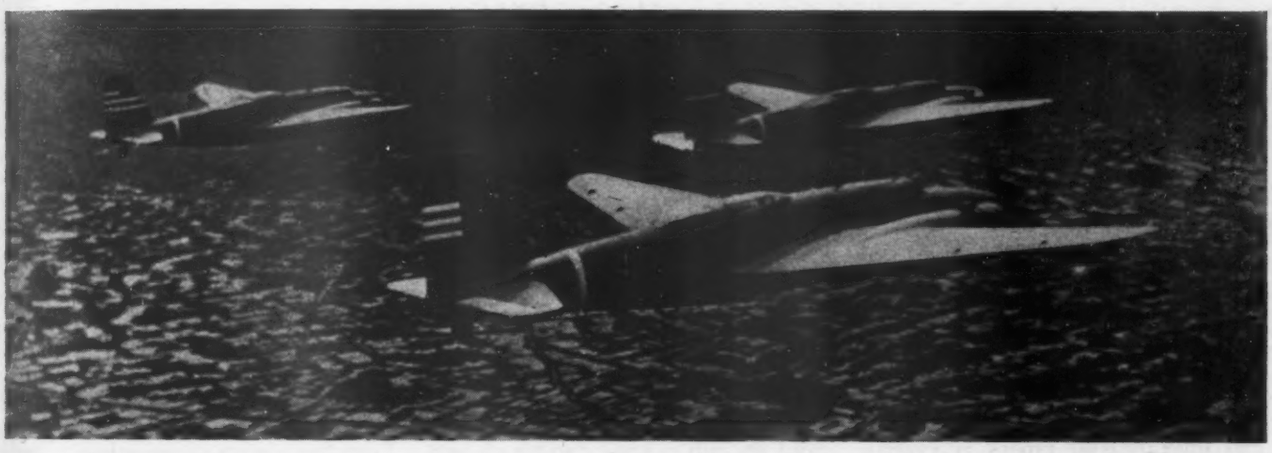


Jap Nakajima 97 bombers are good, efficient planes, but are modeled after European or American types. Although none are as good as our later aircraft types, the Japs have the advantage of numbers—"One Piper Cub in the air is worth a fleet of Flying Fortresses on paper." . . . (Below) North American B-25D rudders and outboard flaps are being built by a former auto company, a part of the gigantic Detroit motor industry swinging to airplane production.

American Airplanes On the European Battlefronts

Initial skepticism turns to unstinted praise and constructive comment as Yankee warplanes prove themselves in the R.A.F.

By MYLES V. CAVE

"Aviation's" British Correspondent

AN INHERENT national pride in the belief that a country's own products are the best is usually responsible for the condemnation of similar foreign products, especially in a field where competition is keen and where tangible and directly competitive facts, figures and performances are available.

So it is with airplanes, as the parent companies producing aircraft, on account of the high degree of specialization involved, tend to collect themselves into small isolated groups of experts. This occurs in every country in the world with the probable exception of Russia.

Thus, when it was authoritatively stated that American warplanes were being considered by the British government there was a good deal of derogatory criticism from all sides. It was argued, and to a degree quite correctly, that Great Britain knew much more about military aircraft than the U. S.

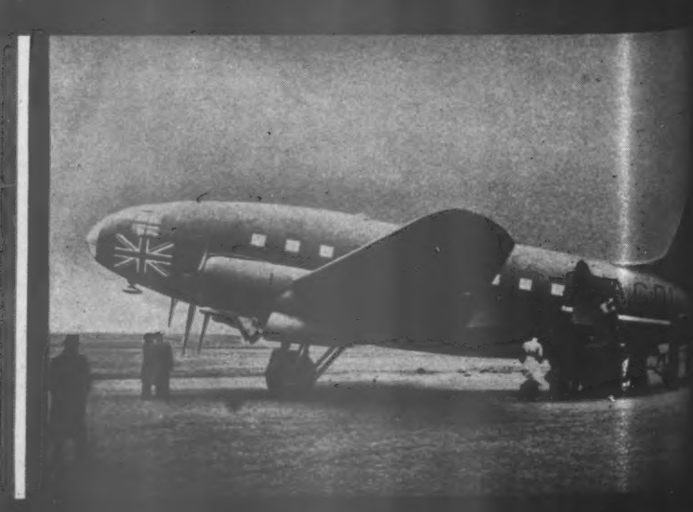
In the early days of the war the correctness of this argument was shown by the superiority of British fighters and light bombers over anything else produced in any country while amongst the heavy long range bombers the superiority of U.S. types was unchallenged, although they were not in service in Europe. In the first months, however, no one visualized that such types would be required and the early planning policy of the Air Ministry provided for only a small number of such aircraft.

In criticizing the types of fighters, and light bombers available in the U.S. in 1939 the critics forgot the ability of American aviation to learn and to bring the results of this education to rapid fruition, despite expansion on an unprecedented scale. With the arrival of increasing numbers of American types it has been interesting to watch the situation change among both aviation experts and the general public. With the R.A.F. flying personnel the position has been different as, apart from early misgivings, there has been nothing but praise and admiration as the machines came into service and the squadrons began building up operational experience with them.

Criticism—perhaps competitive rivalry is a better definition—still persists, but experience shows that these are friendly and usually constructive. From them, a live organization, through an intelligent representative, can learn a whole lot that will influence the design of future types.

AMERICAN PLANES POPULAR

A point of interest that has contributed a lot towards making our people American-airplane-minded is that, apart from Hurricanes and Spitfires, U.S. types have had a very good press in this country and there has always been



an abundance of good illustrations available. With the general public the great gesture of Lease-Lend has undoubtedly been a popularizing influence.

The Flying Fortress was recently "glamorized" in every newspaper for days and there were photographs showing the big Boeing from every conceivable angle so that its popularity, as a news subject, threatened to outshine even meteors like Ann Sheridan.

Right now the Airacobra and the P-38 Lightning are in the spotlight in a big way and since the press has published quite fantastic speeds for them, R.A.F. fighter squadrons literally cannot wait to be equipped with them. It is probable that the new Sabre-equipped Typhoon will be faster than either of them, but so far few people have heard of it, let alone figured on its potentialities.

American aeronautical engineers have been at a disadvantage over Europe on military types because the necessity of keeping level in the great European aircraft competition that has been continuing now for many years, did not strike home sufficiently strongly, situated as they were 3,000–6,000 miles away from the scene. Once the requirements under actual war conditions became appreciated the time lag in producing airplanes to operate under arduous battle conditions was negligible and has been the source of unstinted praise in high quarters here.

Nevertheless it is suggested that companies whose thoughts are fully occupied with production problems should pause and consider the advisability of sending a senior engineer over from time to time to make a first-hand technical investigation of how things are actually working out under service conditions. Most corporations have their own service organizations over here but, right now, these engineers are very harassed folk and have little time to report on and investigate the finer points of design technique. A further difficulty is caused by the necessity of

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Brazil
Fostering Air Expansion

Here are some of the architecturally striking hangars at Brazil's modern air base at Galeao.

While the military services have provided the backbone of Brazilian aviation in the past, public interest and support, coupled with governmental policies, give promise of rapid development to come. This concludes the story begun in the January issue.

By ALICE ROGERS HAGER

Photos by Jackie Martin

ALTHOUGH the genesis of Brazilian aviation was in the civilian Santos Dumont, its primary development has been through military flying. The new Air Ministry has emphasized this military predominance by putting the aero club program, in which all government directed civilian flying is done, under Air Force supervision. With the exception of the commercial transport services, the Air Force is the controlling influence in practically all aeronautical progress. Whether this will be a healthy situation for civil aviation remains to be seen, but the experiment is definitely under way.

In an interview which I had with President Vargas, he made the following statement: "I think it is important to point out the great advance in the sectors of military and naval aviation. The Army aviation, which was created 27 years ago, is nowadays a pillar of national defense. It is significant that it led to the creation of a specialized Ministry for Aeronautics. The comparison between the figures of 1930 and those of 1940 is more eloquent than words. In the former year, the weapon of aviation did not exist. In 1931, the first group of aviation was created and subsequently, this unit was enlarged and the now existing seven regiments with their auxiliary services were allocated to the necessary points of the national territory. From 1933 on, when the services of air bases and airways were founded, the Military Air Post service began to venture into the remotest parts of the country. This service alone uses 150 air fields, covers two million kilometers in 900 trips a year and carries over 50,000 kilograms of mail. The Naval Aviation connecting the south coast of the country adds another 200,000 kilometers, all by military aircraft."

The military pilot in Brazil begins his training at the Randolph Field of his country—Campo dos Affonsos in Rio. It is one of the finest aviation establishments in South America. The administration buildings, barracks, club houses, officers' mess, radio installation and its 15 hangars are excellent, modern construction. The field, however, is badly located, having from 30 to 35 percent foggy days. There is an indefinite plan to move it to some place in the interior where the location will be better and where there can be auxiliary fields, but this will probably not be done for at least another five years. In the meantime, the landing area is being enlarged

to 1,000 by 5,000 meters and two new cadet barracks have recently been built.

Of the 140 odd planes at dos Affonsos, 108 are of United States manufacture. Some of these are assigned to the Air Regiment stationed there, but the majority are for training purposes.

Aerial photography, radio, pilotage, night and blind flying are on the curriculum, which covers a three year course. The ground school subjects are: First year, higher mathematics; second year, aerodynamics, engines, meteorology, radio, navigation, aerial photography, firing practice (both machine gun and bombing); third year, observation. On the flying side, 160 hours of primary instruction is given the first year, using the Brazilian designed and built Muniz M-9; 60 hours advanced follows the second year on Stearman Jrs., and Focke-Wulfe Steiglitz (which will probably be discontinued because of the war); and there is another 100 hours application in the third year on Stearman Srs. and NA-44s. Recently, the Fairchild PT-19As have been added, the original three sent down for use by our Military Air Mission having been bought by Brazil and 40 more ordered from the factory.

During the third year, blind flying is also given in the advanced ships, with 15 hours in the five Link trainers owned by the base, followed by 12 hours under the hood in the ships. The school's commandant, Colonel H. Dyott Fontanelle, one of the heroes of the Robilant jungle rescue in 1931, says that three more Links are needed for his cadets, and many more are wanted for advanced instrument training with the air regiments.

Advanced acrobatics, 40 hours cross country and 15 hours of night flying finish the third year course but no formation work is done until the cadet has been commissioned and assigned to a regiment. The toughest training of all comes when the young tenentes are tucked into the air mail service and sent out to fly the routes. The Air Force uses these routes for the double purpose of establishing rapid communication with isolated districts and as an intensive training in navigation, meteorology and terrain. The pilots operate without radio and with frequently inadequate weather reporting, and their only real safeguards are their own resourcefulness, energy and quick wits. The fact that the list of fatalities has been very small is a testimony to these qualities. They have done much mercy work and have had a measurable influence on the life of the frontier. Because of their hard and dangerous work, they are the nucleus of a first class air force.

BASE AT CAMPO GRANDE

The seven Air Regiments are located at: Campo dos Affonsos, Porto Alegro, Curitiba, Recife, Belem, Campo Grande and Fortaleza (Cears). They are extending their fields at all the strategic points in the country and are moving heaven and earth to get the equipment needed. One example of the program is the new field at Campo Grande, near the Bolivian border. The landing area, 2,000 by 5,000 meters, is complete and one hangar of a new type and the very fine administration building are ready for use. This field will be lighted and have extensive radio and weather reporting equipment, and later a major overhaul shop will be installed. It will be one of the largest air bases in the southern continent.

Even so brief a discussion as this of military flying in Brazil cannot omit the

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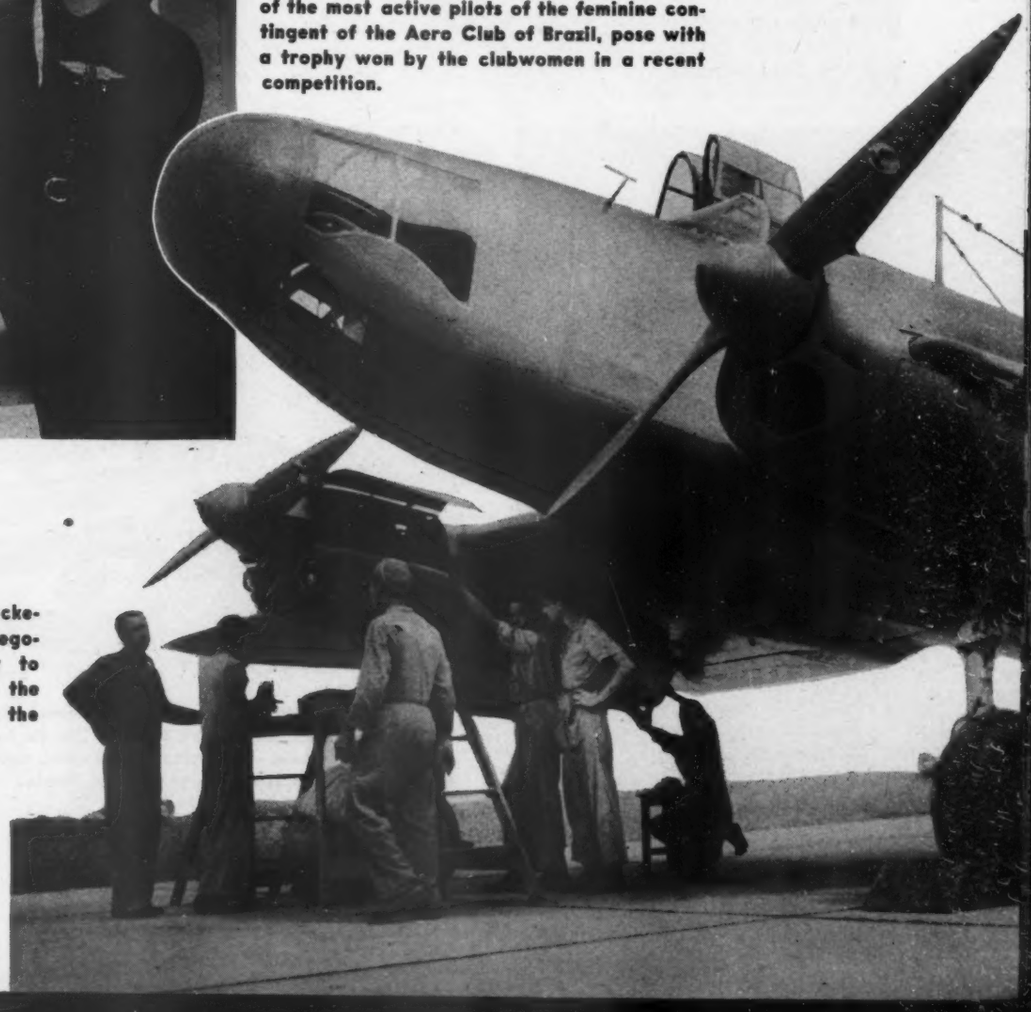
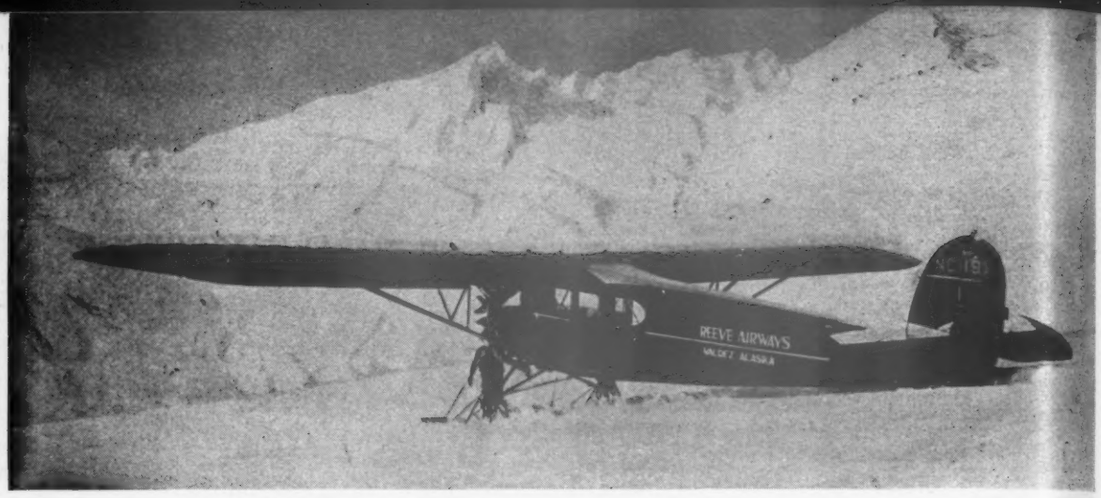
Ada Leda Rogato and Altair Fernandez, two of the most active pilots of the feminine contingent of the Aero Club of Brazil, pose with a trophy won by the clubwomen in a recent competition.



First all-Brazilian-built Focke-Wulf medium bomber. Negotiations are under way to build American types at the Galeao base in place of the German model.



Reeve Airways flies mining supplies from the surface of a glacier at 3,000 ft. altitude. Landings are made up hill, take-offs down hill. Just in front of the plane is a 100 ft. cliff.

Commercial Flying In Alaska

With the establishment of new military airports in Alaska, this is a timely article on the pioneering work of commercial flyers in the Far North.

By RICHARD A. RAMME *Ketchikan, Alaska*

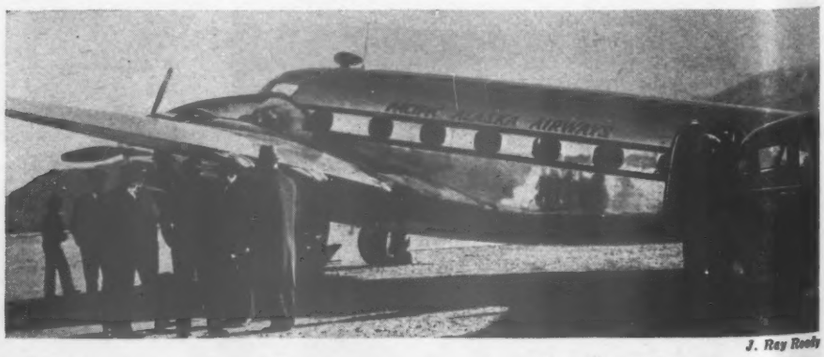
ALASKA is a land of contrast. Its industries are up to date, for to conquer the immense and rugged wilderness of nearly 600,000 square miles and to extract the abundance of natural resources, the most modern machinery is required. Still the Territory remains America's last frontier, and aviation in Alaska combines the romance of the barnstorming days of the roaring twenties with the efficiencies of modern flying.

Aviation has expanded Alaska. Before the coming of the airplane, mining, trapping and other industries were confined to the areas easily accessible and even there, due to the short season and the long, tedious task of hauling supplies either by dogteam or by slow river boat, operations were handicapped and most of the profit went to pay for the tremendous expense of transportation.

With a plane covering the same distance in three hours which with a dogteam would require nearly three weeks of dangerous travel and hardships, the cost of transportation has rapidly decreased and miners, prospectors, and trappers are now profitably engaged in their trades, even in the remotest sections of Alaska, flying in at the beginning of the season and returning with a stake at its end.

Close to 40 airplane companies operate in a territory of less than 75,000 people scattered thinly from Point Barrow to Ketchikan, but even the Eskimo living on the barren tundra of the far north already has learned to distinguish the various planes by the sound of the motor. He gives the plane only a casual glance and does not get excited or worried when he departs by plane to visit the nearest trading post, often hundreds of miles away.

An Eskimo chief, very interested in the strange achievements of the white



J. Ray Roady

Above, Pan American Airways began direct service from Seattle to Juneau in 1940. This is the first Lodestar at Juneau. The six hour flight covers 942 miles. PAA flies on to White Horse, Fairbanks, and Bethel. Left: most commercial planes use floats in summer and skis in winter. Ramme Photo.

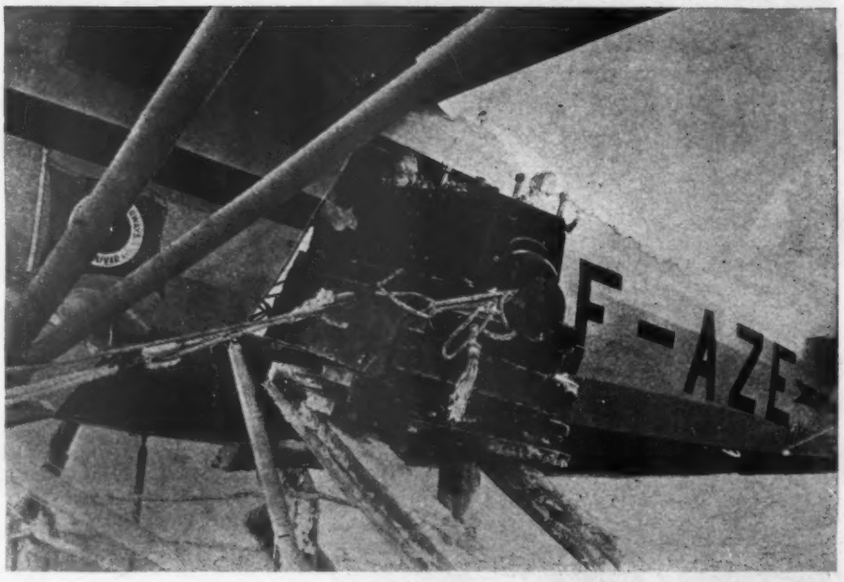
The commercial operator of this ship was hauling mining machinery and landed on a small lake in the interior. As he was unloading the heavy machinery a sudden gust of wind broke his stern line. The tail of his ship swung from side to side and a 1400 lb. engine shifted toward the rear, causing this result. Working in the arctic cold, the pilot and several miners raised the plane with block and tackle, then unloaded the machinery as shown below. Airplane was not damaged. Events of this sort are typical of what commercial pilots must cope with.

man flew to Nome recently to have the ambition of his life fulfilled—a ride in that unique contraption which crawls on the ground on four wheels, the automobile.

Only one of the 40 companies would live up to the popular conception of a modern airline, and that is the Pacific Alaska Airways, a division of Pan American Airways. With its silver colored Lockheeds and DC-3s this company operates a scheduled service between Juneau, Fairbanks and Nome, and in 1940 inaugurated the Alaska Clipper Service between Seattle and Juneau. Now a 14-passenger stratosphere "Lodestar" plane is operated non-stop between Seattle and Juneau, reaching the Alaska Capital six hours after taking off from Seattle.

But Alaska's home-owned air activities, typical of the Territory, are the small aviation companies and individual operators. Having their home port in a community of less than 100 population, they are the local transfer company and means of getting around. They carry most of the supplies and in an emergency form the only link of communication with the outside world.

Through the Arctic winter, sub zero cold and howling blizzards, with daylight so dim that flying is restricted to a four-hour period, and through summers continuously lighted by the midnight sun, when planes and pilots never find a rest for 24 hours at a stretch,



International

Nothing stumps an Alaskan commercial operator. This cow is being pushed aboard a plane at Palmer, Wash., to be flown to Dave Clough at McGrath, Alaska. The trip by land would have taken an entire season and the cow might have died.

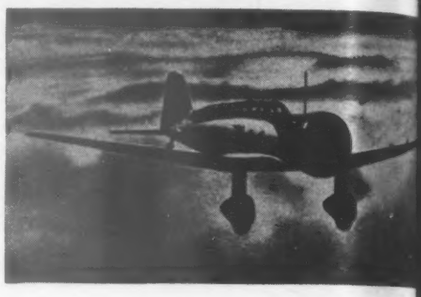
Japanese Aircraft

IN THE following photos and silhouettes of Japanese aircraft it will be observed that while practically all are outright copies of American, German, French or Italian designs, built with or without license in Japan, some are of native design. This seems to be particularly true in regard to naval aircraft—there are reports that the Japanese Navy, unlike the Army, has placed more reliance upon the home-grown product—two examples of which appear to be the Aichi Tok A.I. 92 and the Kawasaki Kawa 102 (see silhouettes below Of course, all Jap airplanes stem originally from foreig sources, but they have developed some good torpedo bombe which are said to be better than anything used in Europea navies. For specifications, see AVIATION'S *Feb., 194* YEARBOOK.

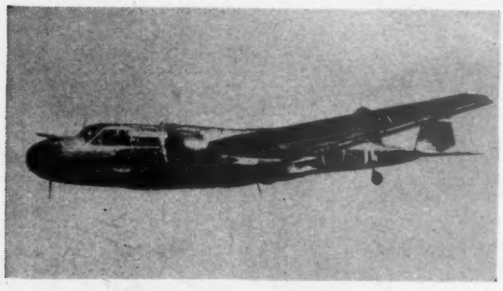
KAWASAKI 95

◀ A Nipponese version of the Curtiss Hawk fitted with their version of the German B.M.W. engine.

▶ Light transport with top speed of 310 m.p.h. Developed from the Northrop A-17.



MITSUBISHI KARIGANE 96

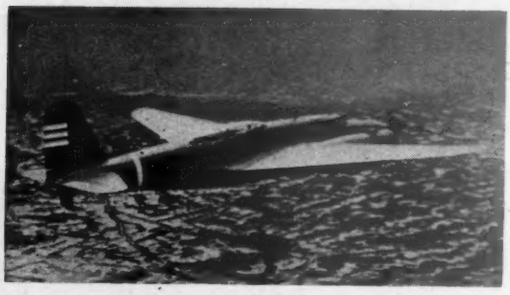


MITSUBISHI SOYAKAZE 96

◀ Four-seater, twin engine bomber developed from the Junkers Ju-86. The range is 1,615 miles.

▶ Light bomber - reconnaissance monoplane the design of which is inspired by Northrop.

MITSUBISHI 96

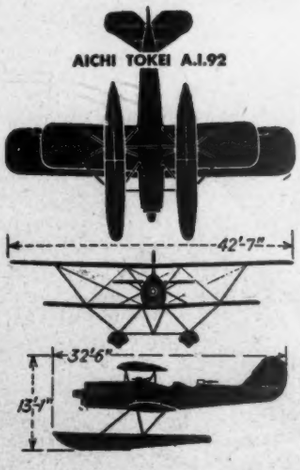


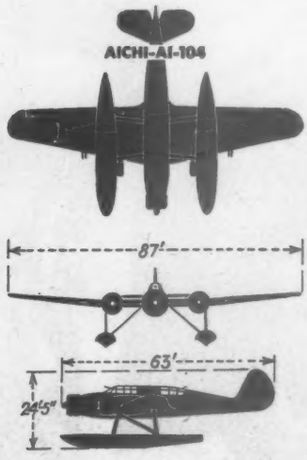
NAKAJIMA NAKA 19

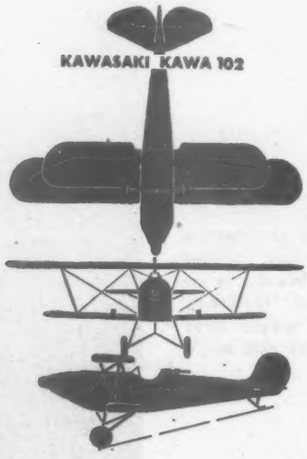
◀ Long range bomber developed from Martin 166. Top speed 224 m.p.h. and range 2,480 miles.

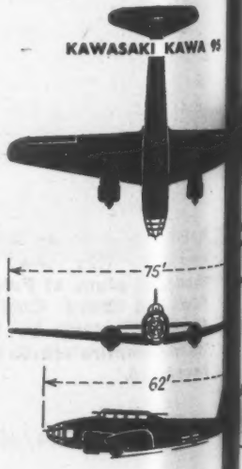
▶ Single-seater fighter derived from French Nieuport-Delage with Jap-built Gnome & Rhone engine. Top speed 201 m.p.h.

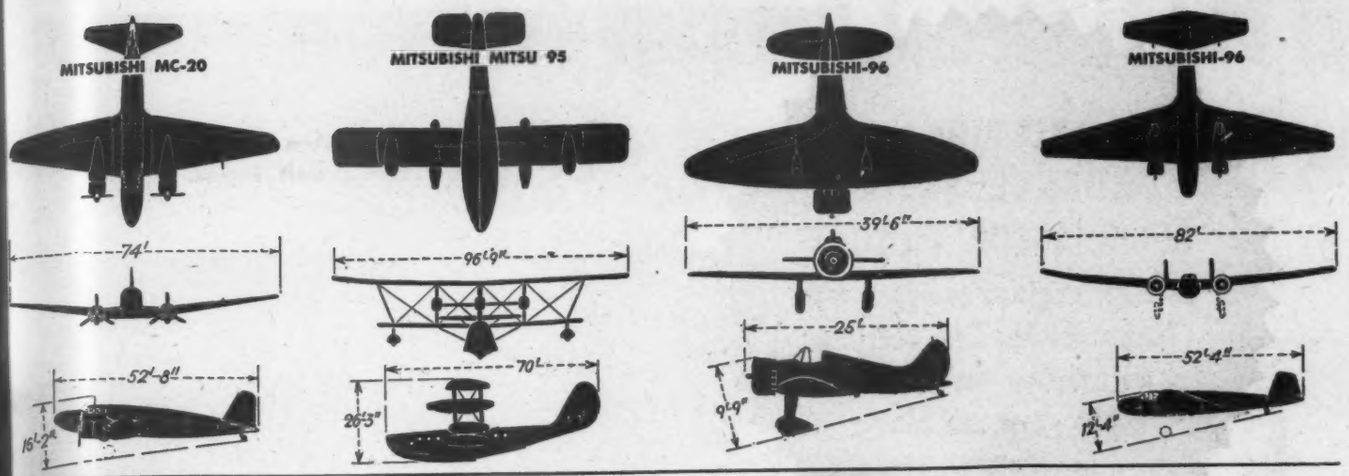
NAKAJIMA 91

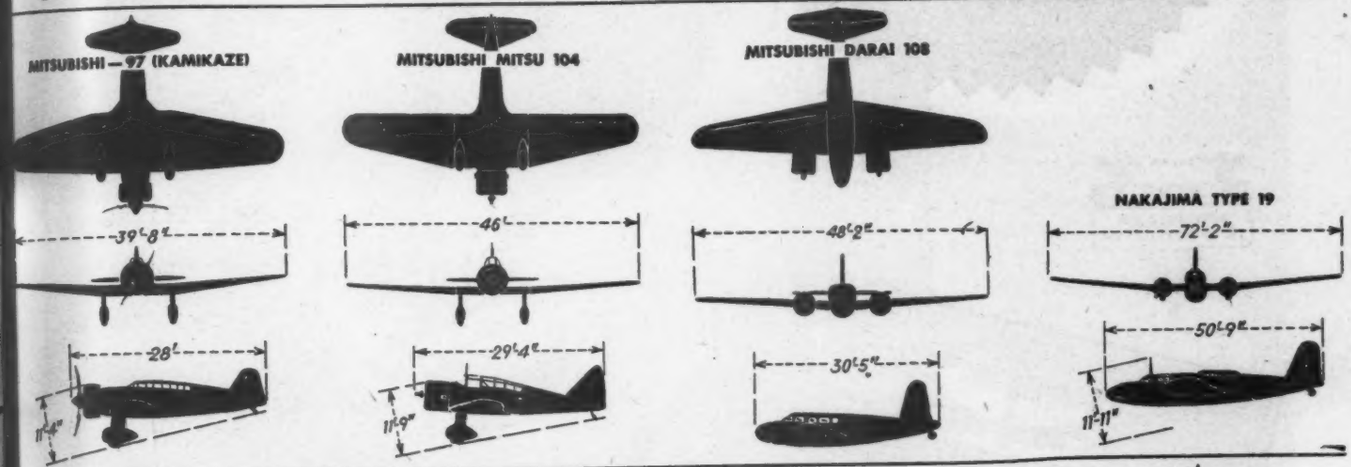


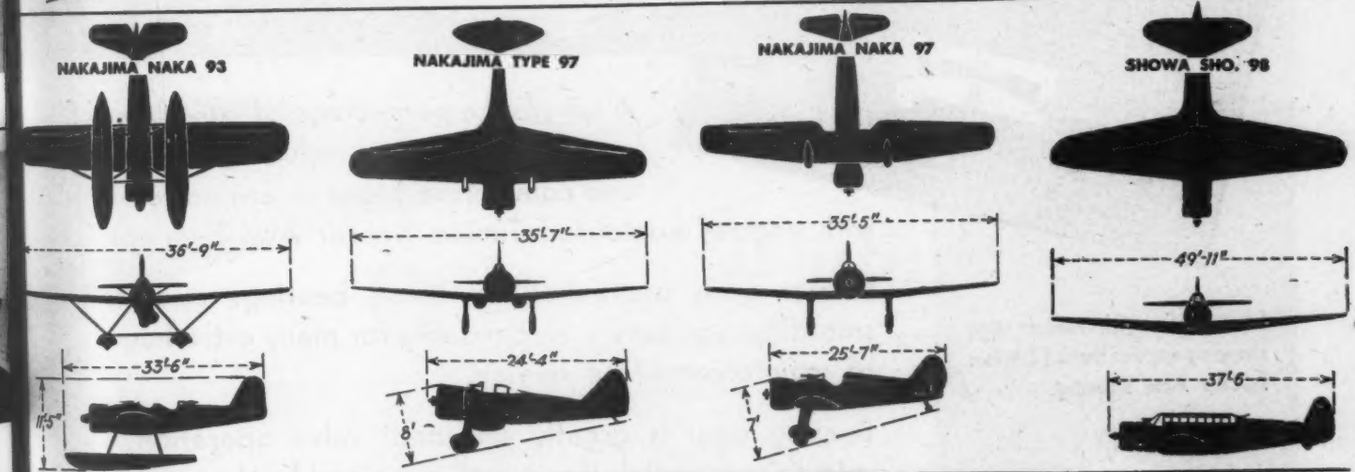


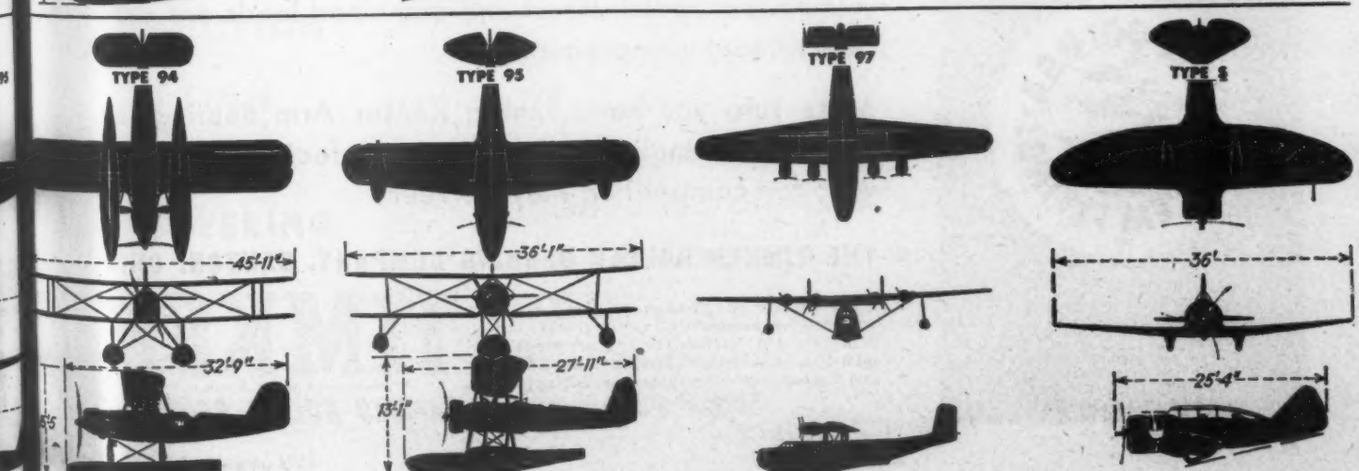




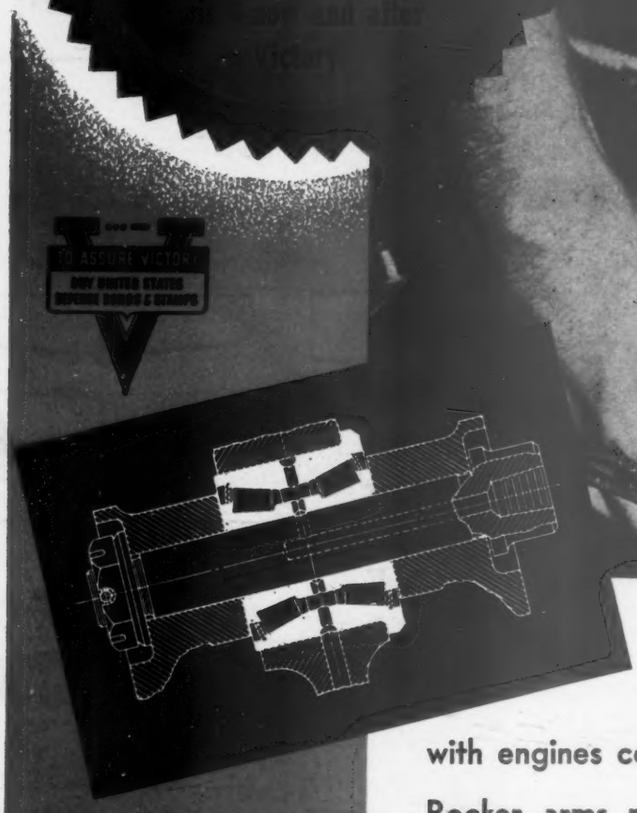

MITSUBISHI MC-20
74'
52'-8"
16'-2"
MITSUBISHI MITSU 95
96'-9"
70'
26'-3"
MITSUBISHI-96
39'-6"
25'
9'-9"
MITSUBISHI-96
82'
52'-4"
12'-4"


MITSUBISHI — 97 (KAMIKAZE)
39'-8"
28'
11'-4"
MITSUBISHI MITSU 104
46'
29'-4"
11'-9"
MITSUBISHI DARAI 108
48'-2"
30'-5"
NAKAJIMA TYPE 19
72'-2"
50'-9"
11'-11"


NAKAJIMA NAKA 93
36'-9"
33'-6"
11'-5"
NAKAJIMA TYPE 97
35'-7"
24'-4"
8'
NAKAJIMA NAKA 97
35'-5"
25'-7"
7'
SHOWA SHO. 98
49'-11"
37'-6"


TYPE 94
45'-11"
32'-9"
TYPE 95
36'-1"
27'-11"
13'-1"
TYPE 97
TYPE 2
36'
25'-4"

Installing Timken Rocker Arm Bearings in a modern radial aircraft engine.



Section through rocker arm showing application of Timken Rocker Arm Bearing.

"A very large percentage of American-made airplanes — including military and commercial types — are powered with engines containing Timken Rocker Arm Bearings.

Rocker arms protected by these bearings operate smoothly, accurately, dependably for many extra hours of maintenance-free service.

Bearing wear is greatly retarded; valve operation is unimpaired; radial, thrust and combined loads are carried without compromise.

Make sure you have Timken Rocker Arm Bearings in the aircraft engines you buy or manufacture after the war; for competition may be keen.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

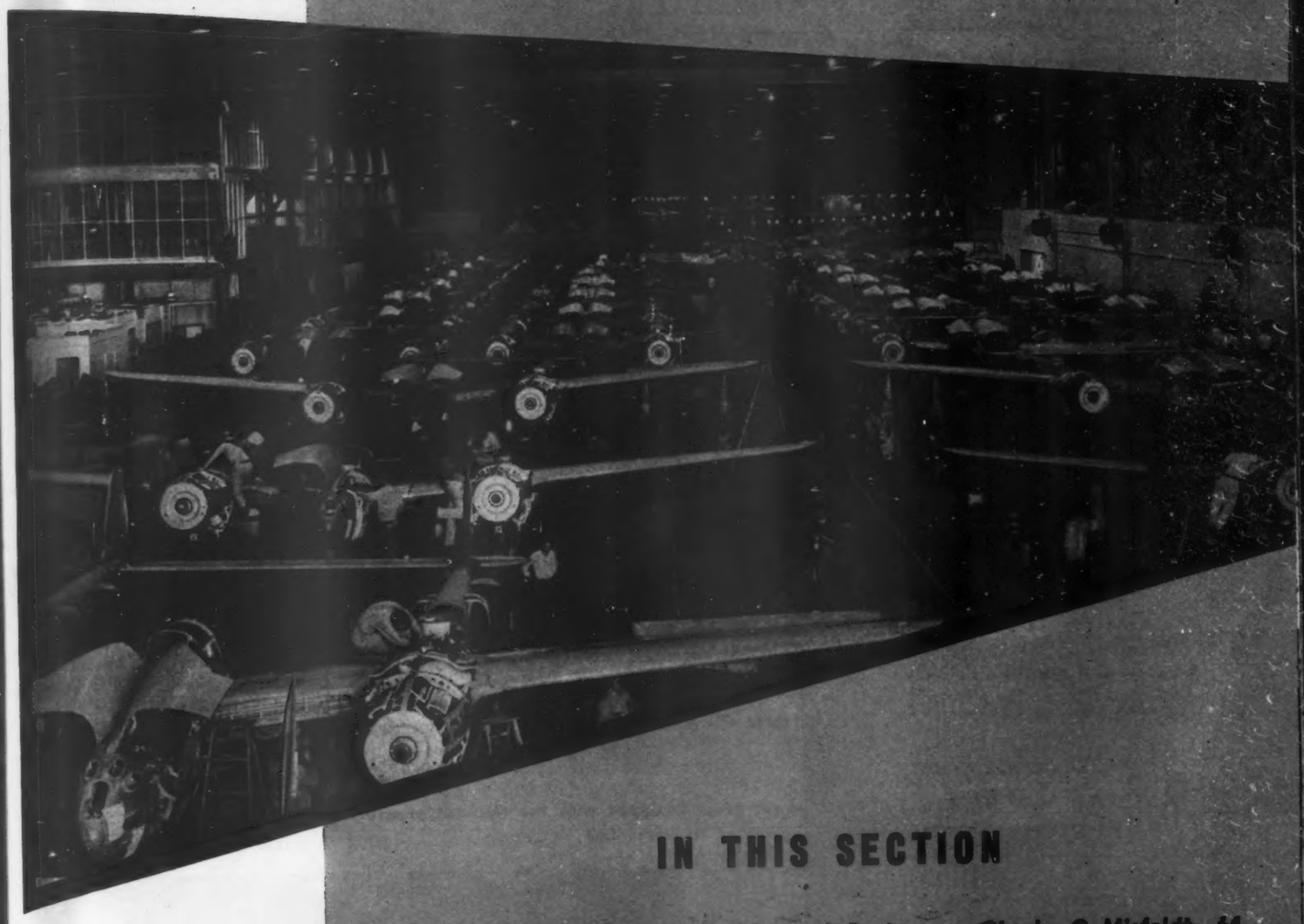
Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives, and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

MANUFACTURING
SECTION OF AVIATION



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PRODUCTION
DESIGN
RESEARCH
ENGINEERING

Speeding Up Deep Drawing Of Aircraft Parts

A complete description of a revolutionary new method of forming aircraft sheet metal parts as now used on Vega production by the engineer who developed the process.

By CHARLES C. MISFELDT
Engineering Consultant

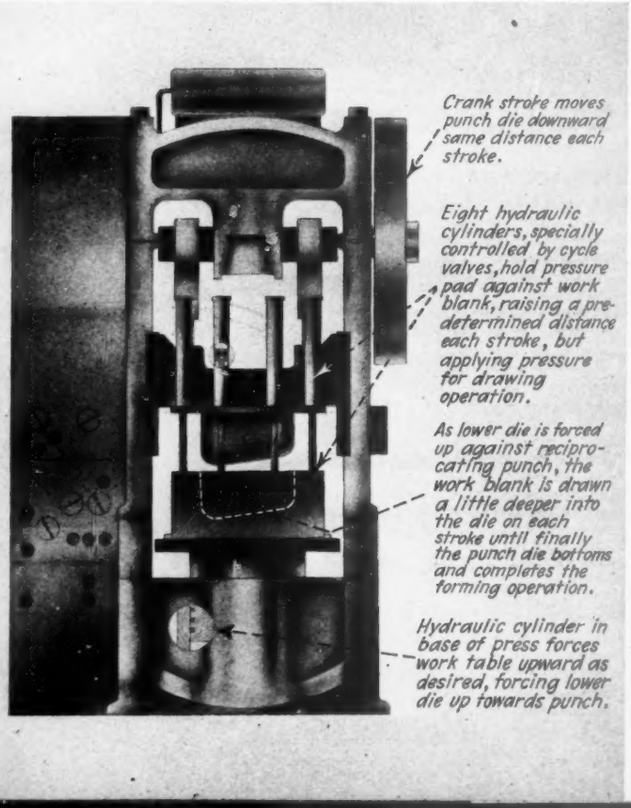
A REVOLUTIONARY new method of forming aircraft sheet metal parts is now being used on regular production by the Vega Airplane Company. This process employs the Misfeldt Progressive Drawing Attachment, developed by the author, attached on a Bliss punch press. For purposes of explanation, however, it is easier to think of the equipment as an entirely new type press.

Many methods of forming aluminum sheet alloys have been used by the aircraft industry, but almost all of them have been based on drawing the material. In this the Misfeldt process is no exception. Our earliest method of forming sheet metal parts was to beat them out by hand over a hardwood form. The limitations of this method are obvious. The development of drop hammer forming represented a big advance. However, the drop hammer technique is not a precision operation and it is still relatively slow. Especially on deep draws the drop hammer becomes a semi-hand operation. It is necessary to work with a series of progressive dies, or to coax the material into a single die by using a series of "shim" pressure pads on top of the die to prevent the punch from dropping all the way into the die during the early stages. This method requires the operator to remove these shims one at a time, and usually to hammer out wrinkles by hand between each blow of the drop hammer.

The Guerin process, on the development of which the writer collaborated, is more nearly a precision production forming method. But since the Guerin process employs the single stroke of a giant hydraulic press it is limited to relatively shallow drawing work. This limit is also defined by the depth of rubber that it is practicable to use for the pressure pad which replaces one of the dies. But the main limiting factor is the depth of draw that can be made in a single operation.

Now that aircraft are being manufactured in large quantities the punch press, so widely employed in automotive production, is being widely adapted to aircraft work. But since the punch press is a single stroke process it is necessary

1. Overall view of a Bliss 5½ 48-in. power press equipped with the Misfeldt progressive drawing attachment. Sketch at left illustrates principle of operation.


Crank stroke moves punch die downward same distance each stroke.
Eight hydraulic cylinders, specially controlled by cycle valves, hold pressure pad against work blank, raising a predetermined distance each stroke, but applying pressure for drawing operation.
As lower die is forced up against reciprocating punch, the work blank is drawn a little deeper into the die on each stroke until finally the punch die bottoms and completes the forming operation.
Hydraulic cylinder in base of press forces work table upward as desired, forcing lower die up towards punch.

to make most deep draws on such a press by means of a set of progressive dies. These dies are expensive to make and the work of setting them up and running the parts through a series of operations is a time-consuming proposition.

In the Misfeldt drawing method we use the punch press mechanism for driving the punch die against the work, but a movable base is used to force the female die up towards the punch progressively, drawing the material a little more with each stroke of the punch. Suitable means is provided for restraining the die blank by means of a pressure pad held against the edges of the blank. Since the punch can be controlled to draw the material by easy stages it is never carried too far past its yield point in any one stage and, therefore, does not work harden and crack. This makes it practicable to produce deep drawn parts at relatively high speed. In one case we found it possible to produce in two minutes a part which had required an hour to form on the drop hammer plus one hour of hand finishing and speed hammer work. Similar results can be achieved in a wide variety of cases where deep drawing is required.

The operation of the Misfeldt press is automatic, requiring only the placing of the blank on the die, setting the press in motion, and stopping it when finished. No hand work is necessary at any time and no use is made of rubber blankets or wood shims. Annealing is not required at any stage of the forming operation, as it is with many drop hammer jobs, and the work can be upset at the end of the forming operation to form beads or embossed sections, and to help eliminate heat-treat warping.

The Misfeldt press incorporates a hydraulic operated bed with a hydraulic-pneumatic pressure pad which is self-adjusting to the bed. At all times throughout the progressive stages of elevating the die the pressure pad holds a constant uniform pressure on the blank, permitting it to flow uniformly around the punch and into the die. As the press is set in motion the pressure pad closes against the blank on the die and the bed plate is progressively elevated. Each time the punch starts on its down stroke the elevating motion of the bed plate is stopped and as the punch completes the downward stroke the draw is completed to a point just past the yield stress of the metal. As the punch starts upward again the die is elevated to its new position to await the downward motion of the punch which will draw the metal deeper into the die. This motion is repeated until the punch has drawn the metal to the full depth of the die and has simultaneously upset the metal or formed any beads called for in the design.

The action of the press is so synchronized and cushioned that the metal being worked is never excessively strain hardened to cause thinning or require annealing. The result is that much

(*Turn to page 203*)

3. Close-up view of hydraulically - operated blank holder securing blank in place preparatory to drawing. (Below).

2. George W. Conlee, operator of the press, is placing a blank in the die preparatory to forming a half of an oil tank.

4. Operator inspects the partially drawn blank. Adjustable bolster raises a certain amount at each stroke, predetermined by an automatic cycle valve. (Below).

5. Operator removes the finished half of an oil tank from the die. (Below).

Charles C. Misfeldt has been active in the aircraft industry since 1917. He worked in the Breguet factory at Villa Coubley, France, while serving in the U. S. Army Air Corps. In 1929 he started with the Northrop Avion company and served as factory superintendent of the Northrop Company in 1930, when the Northrop Alpha was placed in production. At that time he developed a number of novel production techniques, including the traveling drill table for drilling all rivet holes in stacks of sheet metal parts. He also experimented with rubber for shearing and forming aluminum sheet metal parts. In 1933 he was supervisor of construction on the first Lockheed Electra produced by the Lockheed Aircraft Corp.

Later Mr. Misfeldt was in charge of Tool Design and Tool Engineering for the Douglas Aircraft Company for a number of years. While with the Douglas Company he introduced the use of die castings to the aircraft industry. He is now active in the developments of die casting extrusion-moulding techniques in addition to his work on sheet metal forming.

First War Time Meeting Of the Institute of The Aeronautical Sciences

War time status of the aviation industry reflected in character of papers presented — primary emphasis on practical problems of production.

All Sketches by Mrs. E. P. Korn

THE war time status of the aviation industry was clearly reflected in the character of papers presented at the first war time meeting of the Institute of the Aeronautical Sciences. There was a notable predominance of studies concerned with practical problems of production methods and quality control in mass output as contrasted with the normal emphasis falling largely on problems of pure research and design. There were a sufficient number in the latter categories however, to indicate that these vital fields are not being dangerously neglected.

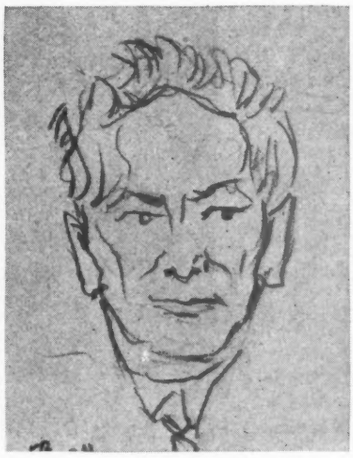
It is, rather, an encouraging and hopeful demonstration that unregimented scientists of this free nation are voluntarily disciplining their inquisitive minds to seek first the answers to those questions most directly concerned with the immediate needs and quickening tempo of what promises to be mankind's greatest cooperative achievement in all recorded history.

The tenth annual meeting of the Institute was held behind doors which for the first time, were closed to the general public. For three days, top flight men in the nation's most vital industry exchanged views and experiences on research and technical problems.

The presentation of papers was preceded by the Honors Night Dinner on Jan. 27 at which awards for merit were made. Hall L. Hibbard, vice-president and chief engineer of Lockheed Aircraft Corp. was inaugurated as president of the Institute for 1942, succeeding Frank W. Caldwell. Awards for notable contributions to the industry were made to Juan T. Trippe, Dr. Theodore von Karman, Melvin N. Gough, Ernest G. Stout, Major Harry G. Armstrong, and Dr. Horace R. Byers. Institute fellowships

MAJ. L. D. GARDNER

A. V. De FOREST



W. A. REICHEL

CLARK B. MILLIKAN

F. W. REICHELDERFER

FRED E. WEICK

IGOR SIKORSKY

RALPH UPSON

were also presented to ten outstanding figures in aviation, and hononary memberships were conferred upon five governmental officials engaging in aviation activities. Maj. Lester D. Gardner, executive vice-president of the Institute, whose able supervision of the meeting under difficult circumstances was an outstanding achievement, also announced last year's gifts to the Institute.

While space limitations and military restrictions preclude the possibility of abstracting all of the papers presented, AVIATION has sought to present brief digests of the content and conclusions of those available papers which contained material of more direct concern to the men engaged in the productive effort.

It is earnestly hoped that this presentation will prove of practical value to countless engineers and executives for whom the pressure of immediate tasks made it impossible to attend the sessions or study individual papers with the thoroughness they justly deserved.

In an appendix (page 000) there is listed, by subjects, a complete bibliography of papers presented and their authors.

PRODUCTION

The maximum utilization value and most effective routine control of X-ray inspection procedure was discussed in a paper by Mr. B. C. Boulton (Lockheed Aircraft Corp.). The fundamental conclusion reached was that the primary function of X-ray inspection is to aid in the development of correct design, to improve die and pattern equipment, and to establish proper foundry technique. The second basic function is that of maintaining a continuing control over foundry practice to insure maintenance of quality.

Except for certain classes of parts, the use of X-ray inspection for routine work is neither sound nor economical. Quality standards can be maintained by utilizing X-ray primarily for routine control of design practice and processing technique. Radiographic inspection alone has only qualitative and comparative value in determining the structural airworthiness of parts with defects, and does not provide a valid criteria for rejection unless interpreted by static tests.

A number of important observations were made during the course of the Lockheed studies. A reduction of 37 percent in rejections was obtained through the use of permanent metal plate or wood board patterns, as compared with the use of either metal or wood loose patterns. Moreover, the use of high-type pattern equipment requires less skilled help and materially increases the rate of production.

X-ray inspection of forgings is unnecessary once proper processing routine is established. Forging defects are best determined by photomicrographic analysis of sections at critical points. Steel forgings are more satisfactorily and economically inspected magnetically than by X-raying them. The reverse is true with steel castings, however. Hydraulic pressure tests are essential in the case of hydraulic castings, and X-ray inspection is unnecessary once proper design and foundry technique have been established.

Defects which can be revealed by X-ray have a marked detrimental effect on the impact and fatigue properties of castings, much greater than the effect on static strength. Impact properties are practically proportional to elongation values, thus emphasizing the importance of avoiding very low elongations and indicating a simple method for determining the impact quality of suspected materials.

In his paper on magnesium-silicide-aluminum alloys, Mr. Kirby F. Thornton (Aluminum Company of America) points out the economic advantages which can be gained through use of lower strength, lower priced and more readily workable materials than the high strength aluminum alloys now generally employed in aircraft construction. Many aircraft parts, particularly fairings, cowlings, skin covering, etc., are frequently not intended to carry high stresses. Further, because of the necessity for a certain inherent stiffness or because of handling considerations, it is not always possible to use material as thin as would be permitted by consideration of design stresses alone. The magnesium - silicide - aluminum alloys 53S, 61S and A51S possess the desirable characteristics of ease of fabrication, inherent resistance to corrosion, adaptability to spot welding and ease of forging when compared with such commonly employed structural alloys as 24S and 14S.

In their paper on the progressive use of plywood in airplane construction, Messrs. Hugh C. Bersie and Edwin R. Clarke (Haskelite Manufacturing Co.) recognize the inadequacies of present plywood specifications and submit a new set that at least establishes uniform strength properties. The adoption of a rigid system of uniform or standard constructions is also favored to facilitate rapid production. It is pointed out that the availability of material and labor, the speed of production, the simplicity and comparatively low cost of tooling a factory, and the satisfactory airplane produced, combine to make plywood aircraft production an important consideration during the emergency.

Advocating wider use of plastics and allied materials in aircraft construction, Mr. George W. DeBell (Glenn L. Martin Co.) contends that it would be pos-

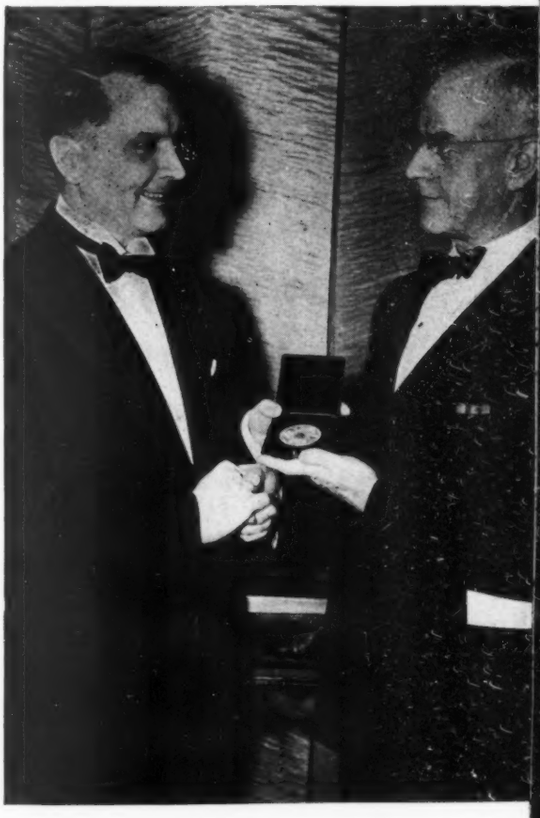
(*Turn to page 204*)

Melvin N. Gough (l.), senior test pilot of the National Advisory Committee for Aeronautics, receives the Octave Chanute Award from T. P. Wright, assistant chief, Aircraft Branch, War Production Board.

Wide World Photo

Brig. Gen. Donald H. Connolly, military director of civil aviation (r.), presenting the Daniel Guggenheim Medal to Juan T. Trippe, president of Pan American Airways.

Wide World Photo



Quality Control of HOLLOW STEEL BLADES

By H. P. REIBER

Quality Engineer, Blade Plant, Aviation Manufacturing Corporation, Lycoming Division

Presented at a meeting of the Institute of the Aeronautical Sciences at Philadelphia, this paper describes the methods and problems in developing hollow steel propeller blades.

PROPELLERS with diameters of from 10 to 18 ft., driven by engines of 800 to 2,500 hp. for both commercial and military aircraft, have sounded a call for attention to designs that will comply with these advanced conditions. Here the matter of strength-weight ratio is pre-eminent in the minds of designers. They are confronted with blade thickness to chord or camber ratio, which is an influence on tip flutter characteristics; torsional stiffness, a function of profile shape and modulus of elasticity and centrifugal force. Thus in the last analysis, it is evident that designers have and are attempting to obtain a weight reduction, yet, produce an airworthy blade.

In the first appearance of the hollow steel type, a laminated sheet steel blade was produced that, by virtue of low vibration symptoms, was proven satisfactory for service. Even though the hollow steel type fulfills most requirements, a solid steel blade has appeared with a unique airfoil section simulating a semicolon. With a thin airfoil section, and boring out excess metal in the shank section, this blade compares favorably in weight with aluminum alloy blades. For the larger diameters and horsepower requirements it is doubtful whether the weight can be reduced sufficiently enough to be a competitor of the hollow steel type.

A two-piece hollow steel blade was conceived some twelve years ago, as well as a single piece blade formed from a tube, both of which have proven to be formidable in the solution of the strength-weight ratio problem.

A short dissertation on operating loads and optimum features in the blades of today as well as those of tomorrow will serve to substantiate the valuable properties of hollow steel blades in their ease of fulfilling all requirements. Blade forces are the prime factor in deciding the loads in other parts. Take-off and dive are airplane attitudes that impose the highest loads, the average propeller developing about 100,000 lb. centrifugal load, with torsional torque or twisting moments from 1,500 to 10,000 inch-

Fig. 1. An etched cross section of the two-piece propeller blade. Note the desirable feature of virgin metal at the leading edge.

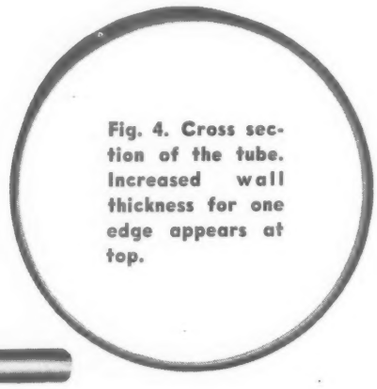


Fig. 4. Cross section of the tube. Increased wall thickness for one edge appears at top.

Fig. 5. Spiral line on tube shows increased wall thickness for one edge, also shown in Fig. 4.

Fig. 2. Internally swaged seamless steel tube used in the present Lycoming process.

Fig. 6. Rust inhibited water under pressure is maintained in the tube while it is bent.

Fig. 3. Further step in the building of a Lycoming blade, upset and lathe-turned to proper wall thickness on a mandrel.

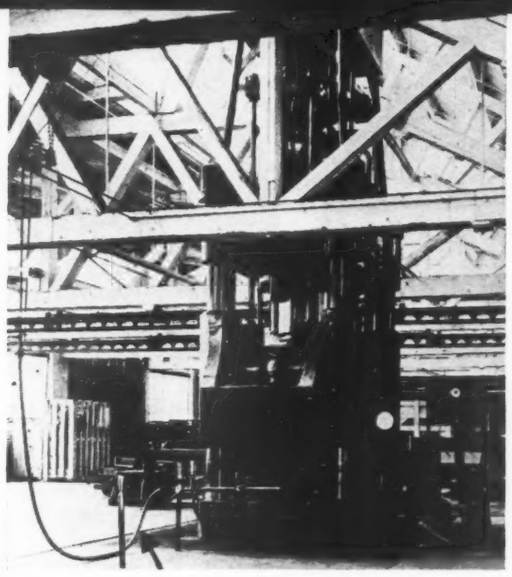


Fig. 8. The 1000 ton press with a blade registered in the dies. Note the gas line connection (arrow) attached to the blade, which at the proper moment must convey the high pressure inert gas to the blade interior. The intense pressure from the press to the dies assures a fixed blade shape interior.

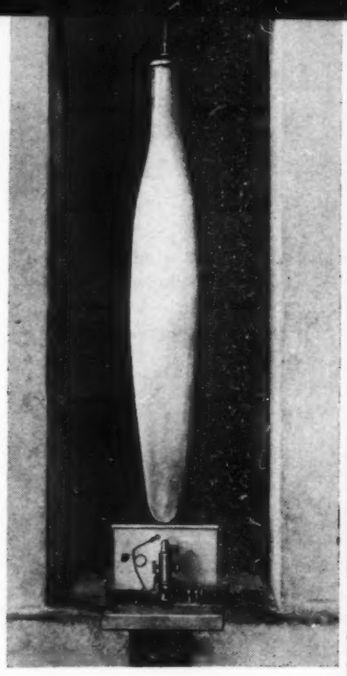


Fig. 11. The polished blade is "hung" above a microscopic cross hair disc to obtain measured values of center of gravity and subsequent vertical balance.

Fig. 7. While still cold and filled with water, the bent tube is partially flattened.

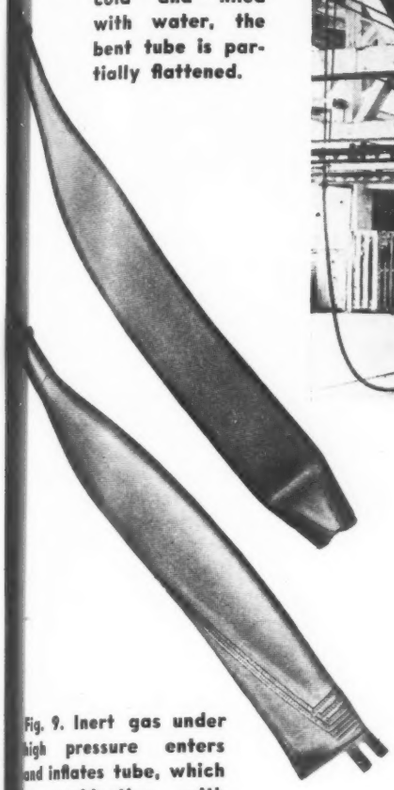


Fig. 9. Inert gas under high pressure enters and inflates tube, which in combination with dies creates blade shape. Edges are resistance seam welded.

Fig. 10. Cross section of the blade with the copper fillet in the trailing edge.

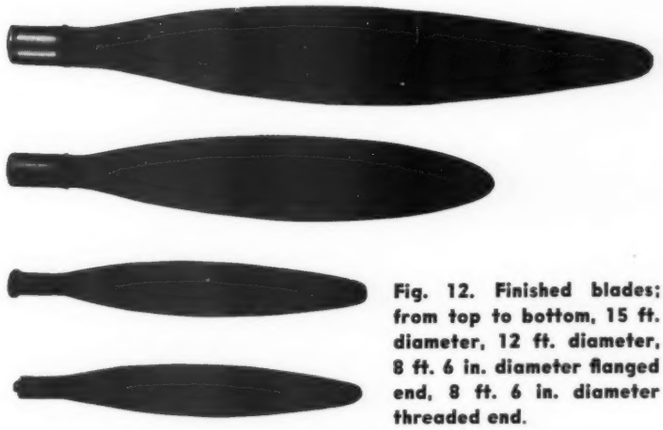


Fig. 12. Finished blades; from top to bottom, 15 ft. diameter, 12 ft. diameter, 8 ft. 6 in. diameter flanged end, 8 ft. 6 in. diameter threaded end.

pounds. Bending moments, resulting from the combination of thrust, torque, and centrifugal force acting on the deflected blade, range from 20,000 to 65,000 inch-pounds for the larger blades. Operating steady, stresses range from 25,000 to 30,000 p.s.i. and vibration stresses between 12,000 and 14,000 p.s.i. for the outer third and 5,000 to 6,000 p.s.i. for the inner third. Hollow steel blades, with ever increasing loads and severe operating or service conditions, are constantly expected to accommodate these requirements with a reduction in weight. Designers and improved manufacturing methods in the past few years have in the light of extensive research work been able to produce hollow steel blades that admirably fulfill the necessities. More efficient profiles designed to delay compressibility have been developed, thinner plate and wall thicknesses are used, abrasion resistive properties have been applied, as well as improved magnaflux methods, X-ray technique, better steel and intensive metallurgical consideration.

Fundamental and of utmost importance in the consideration of any part, particularly one subject to heavy loadings, is the selection of the material to be used. Selection is based primarily upon the ability and ease in which the chosen material can be processed into the completed object with the desired physical properties.

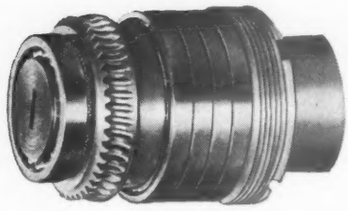
The two-piece blade has used, for about ten years, chrome-vanadium alloy steel classed as SAE 6130, primarily by virtue of the suitability for Atomic-Hydrogen Welding.

Lycoming process blades are produced from seamless cold drawn tubes of nickel-chromium-molybdenum steel SAE 4330-X.

In selecting SAE 4330-X as the material, two major and conflicting requirements were given consideration. First, the material had to possess a considerable degree of hardenability because of the necessity of quenching and forming the blade simultaneously in metal dies. Fortunately, increased hardenability is accompanied by suppressed critical temperature which is a distinct advantage in the quench-forming operation because of delay from furnace to press.

Secondly, before the blade can reach the press operation it must have been successfully resistance-welded, and copper brazed. Here a dilemma was faced; in order to obtain good hardenability for the quenching operation we increase the welding hazard. Lycoming process blades were about the first to have used SAE 4330-X and at the time it was a special analysis. Carbon is held to five points .26 to .31, while the other elements are standard ranges, except manganese which is held to the low range of .30—.60. Manganese is a

Fig. 13 and 14. Typical shank end, threaded on outside diameter (left), and (below) assembly of pilot bearing, worm gear nut, bearings and blade retainer nut.



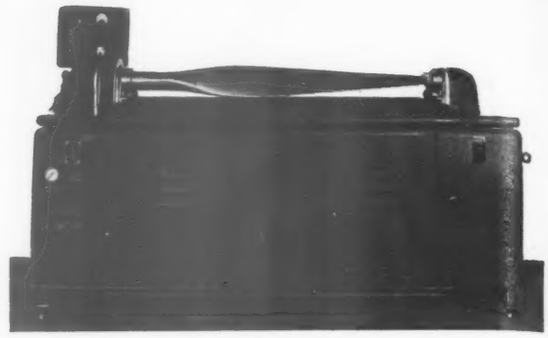


Fig. 15. Typical charging set-up for magnetically inspecting the blades by the magnaflux method.

Fig. 16. The blades are passed through the demagnetizing coil (below) after magnafluxing.

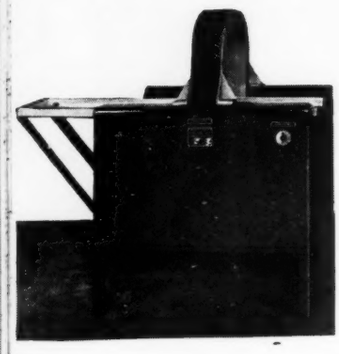


Fig. 17. Note the dark copper distribution on the inside contour and seam weld slugs on this typical example of an X-ray inspection.

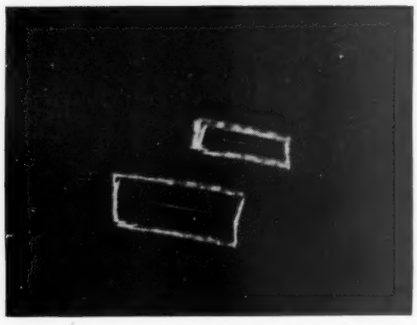


Fig. 18. A tube mill inclusion in the steel, as disclosed by the X-ray.

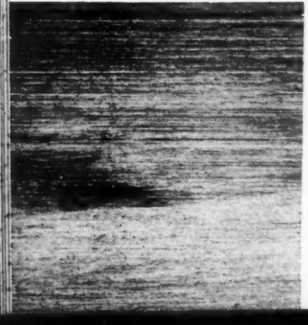


Fig. 19. The same defect, shown in Fig. 18, as discovered by the magnaflux method.

bad offender where weldability is concerned, and while sulphur and phosphorus are frowned upon, no serious difficulty has been experienced with steels obtained under a .04 maximum limit which is commercial. Of course, steel is obtained as "Aircraft Quality" which implies rigid inspection, with the ordinary rejection clause.

An extended research was carried out to ascertain satisfactory technique in welding this material, which at the time of development work, was listed by handbooks as being non-weldable.

WELDING TECHNIQUE

The actual technique for resistance-welding the material is, of course, a function of tube thickness. It was found necessary to use long duty cycles with a burst of current or impulse in each spot. The criterion for suitable welding technique is a level hardness in the material through the overlapping spots. Hardness gradients represent stress gradients which induce crackage. Keep the hardness uniform, by controlling the transformation temperatures, and crackage is non-existent. Rejections for resistance welding technique are considerably less than 1 percent, which is good practice for even straight low carbon work.

In the Lycoming process emphasis is placed on the inside diameter condition. Welding must take place over an annealed and hot formed tube. Of course, it is quite evident that any scale condition would seriously affect the quality of welds. Consequently, at any operation when the surface is exposed to heating, a protective gas atmosphere is utilized. To protect the inside diameter, the tube is closed and hydrogen gas, or completely dried combusted gas, is forced through gas fittings in the blade. Protection of the external surface is accomplished with atmospheric control in the orthodox manner.

The hardening process performs satisfactorily, provided adequate hardenability in the steel is available and ample time for solution has been allowed.

In the two-piece blade the camber and thrust plates are first variegated taper milled, die formed cold in a press, placed in a blade shape welding jig, with an interiorly inserted three-piece mandrel, then welded around the tip, leading and trailing edges, and shank seam by the Atomic-Hydrogen method. The blade is then heated and oil quenched and finally drawn. Numerous operations follow such as lathe turning and grinding the shank end, profiling, fitting templates, polishing for balance, checking dimensional tolerances, balancing and chrome plating.

Illustration Fig. 1 shows an etched cross section of the two-piece blade. The two atomic-hydrogen weld beads on the edge are clearly shown as well as the beads along the trailing edge. Copper fillets are subsequently formed along the interior of the leading and trailing edges.

In the original tube processed blade in one form, the tube is swaged and upset on the shank end. A mandrel is forced into the tube and wall thickness generated on a lathe, after which the mandrel is removed. A spinning and welding operation closes the tip end. The tube is then hot formed between dies while air pressure is forced into the blade interior. Subsequent balancing and polishing complete this type.

Another version of this same process involves a mandrel with extended lips along the leading and trailing edges. The mandrel is forced into the tube and protrusions formed on the tube which are the leading and trailing edges. A process of shaped rolls through which the tube is forced, draws down the two edges to finished size. The spun and welded tip, die forming, balancing, and finishing conclude this method.

A tremendous continuity of manufacturing difficulties has arisen during the processing of hollow steel blades. Certain imperfections existed that appeared insurmountable and duplication or line production has been sought.

LYCOMING PROCESS BLADES

Outstanding improvements accomplished by this process to surmount a

myriad of troubles are: an increase in physical properties and fatigue strength; substitution of resistance-welding for the torch method; elimination of manual handling and personal errors to a large degree; reduction in the length of the welded portion, none of which is across the major stress lines; polished internal surface free from decarburization; superficial nitrided finish to obviate abrasion and increase the fatigue limit; absolute freedom from residual stresses; almost perfect balancing and interchangeability, and finally, a line production method that inherently does produce repetitive blades.

In the initial effort an oval mandrel was forced into an internally polished tube and taper lathe turned, for wall thickness. The removal of the mandrel presented a problem, and even at this early stage this operation was abandoned.

A round mandrel was next used, the exterior surface of the tube, which was shrunk on the mandrel was milled with an hour glass-shaped cutter in four positions to obtain the proper wall thickness. The tube was then flattened over a two-lipped tongue or mandrel and then die formed. At the period of welding it was concluded to weld both the leading and trailing edges so as to obtain sufficient metal with which to finally dress to proper edge radius. The leading edge collapsed under the welding rolls and then there was conceived an insert along this edge for support. The insert added further difficulties rather than improvement, so this was abandoned.

The culmination of these imperfections is the expedient used in the present Lycoming process. An internally polished and swaged seamless steel tube is used as shown in Fig. 2.

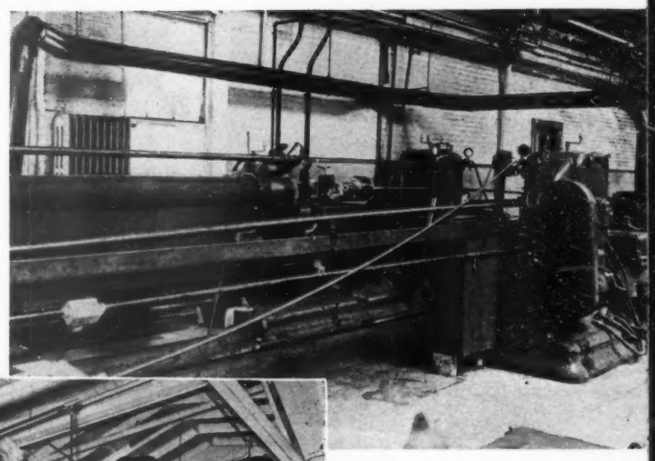
In Fig. 3 the tube is shown upset and lathe-turned to proper wall thickness on a mandrel. Figure 4 shows a cross section of the tube with the increased wall thickness for one edge appearing at the top of the figure as well as by the spiral line on the tube in Fig. 5.

A diaphragm is welded into the large open end and a pipe connection on the smaller flanged end. Rust inhibited water under pressure is maintained in the tube of Fig. 6 while it is bent to a curvature such that the convex edge will provide a seamless leading edge, of proper planform, when subsequent operations develop the circular sections into airfoil shape. While still cold and filled with water, the bent tube is partially flattened as shown by Fig. 7. The circular header on the large end is removed, the water drained, the sheared and welded, and a forked locator attached. Next, the flattened tube is hot preformed

(*Turn to page 196*)

Fig. 21. A blade, perforated by 30 cal. steel jacketed rifle bullets, was supported in a stationary position at the shank only.

Fig. 20. A controllable pitch propeller set-up for a vibration stress survey.



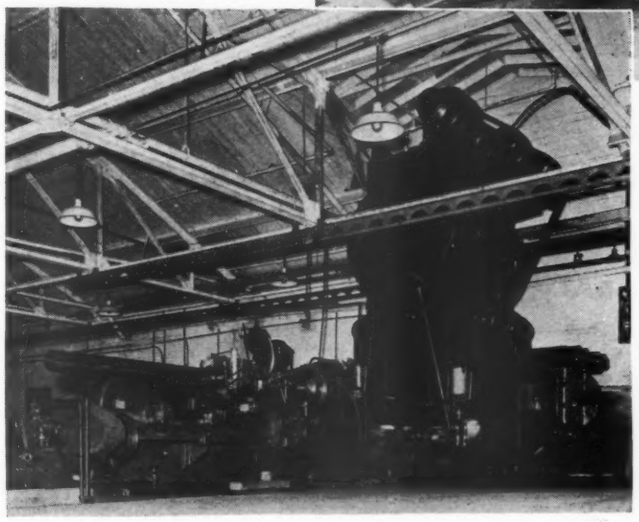


Fig. 22. The rough tube is in the process of internal polishing for removal of scratches, scale and decarburization. Note traversing piston which presses the endless emery cloth belt against interior wall of the rotating tube.

Fig. 23. View of the toggle swaging machine which reduces shank end of the tube to a fair contour to obtain proper wall thickness.

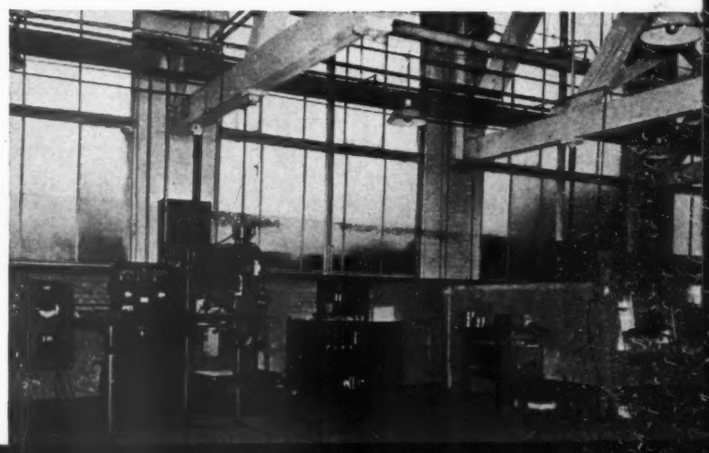


Fig. 24. At left, the trailing edge of the blade is shown passing through the rolls of the resistance welder, and on the extreme right, a blade with protective gas atmosphere connections is being preheated in the resistance welder furnace.

Military Mission... KOLLSMAN'S LOCKHEED LABORATORY TESTS ARMY-NAVY AIRCRAFT INSTRUMENTS

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Geometric Airfoil Characteristics

It is always a help for design engineers to have charts to save calculations. In the following article there is presented preliminary design information calculated from certain N.A.C.A. airfoil sections.

By **CHARLES F. MARSHNER,** *McDonnell Aircraft Corporation*

IN the preliminary and detail design of airplanes it is very often necessary to quickly ascertain or check pertinent dimensional data concerning the wing. The usual method of determining this data from layouts (which sometimes do not even exist in the case of preliminary designs) is accurate but very often time consuming.

An examination of the geometry of airfoil sections shows that a great many, if not all, of the geometric characteristics of airfoils may be readily calculated by using charts to determine certain parameters and applying these parameters to simple equations involving the airfoil chord and thickness ratio. Charts and equations from which airfoil ordinates, depths, perimeters, section areas and section moments of inertia can be calculated are presented here. Others, which permit the rapid calculation of the mean aerodynamic chord, lift distribution, and further aerodynamic properties may also be developed from available N.A.C.A. reports. All charts given here are for the N.A.C.A. 230 series of airfoils, but separate sets may be devised for any systematic airfoil series.

The Ordinate Chart, Figure 1, provides a painless method of determining airfoil ordinates for any given thickness ratio in terms of chord. Figure 1 was obtained merely by plotting the airfoil ordinates against the thickness ratio (both in fractions of chord) from the data of Reference I. Charts similar to Figure 1, but for the lower nose, upper tail and lower tail ordinates, may be similarly plotted from the Reference I data to completely define the airfoil.

It will be noted that the lines of the Ordinate Chart are slightly curved. This is caused by the N.A.C.A. method of uniformly increasing airfoil dimensions about the curved camber line rather than the straight chord line. The amount and position of maximum camber determines the degree of curvature of the Ordinate Chart lines.

While the Ordinate Chart is not recommended for use in determining intermediate stations on straight tapered wings where these stations may be obtained by the usual procedure, it is useful in both preliminary and detail design. Generally the chart will reduce the time required to determine airfoil ordinates by about 65 percent.

The section thickness ratio and chord for use with the Ordinate Chart are easily calculated once the wing root and tip sections are fixed. It should be pointed out here that the thickness ratio of a tapered wing does *not* usually vary proportionately with span and that the thickness ratio should therefore be calculated separately for each station.

In reduced scale work, such as is often encountered in preliminary design, the drafting of airfoil sections is speeded up without loss in accuracy. In detail design the chart is especially useful for quickly checking clearances on equipment such as guns, controls, flotation gear, bomb racks, etc. to be installed within the wing at intermediate stations which are not lofted. It is of further assistance in the fairing of airfoil sections which have compound curvature, such as wing tips. Tips may be readily and accurately faired by using the desired tip plan form and then plotting and fairing the thickness ratio curve in the vicinity of the tip. Tips laid out

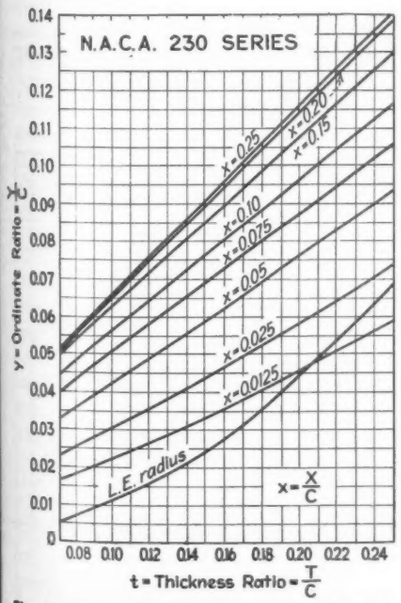


Fig. 1. The ordinate ratio y/c plotted against the thickness ratio T/C for the upper nose ordinates of the N.A.C.A. 230 series airfoils.

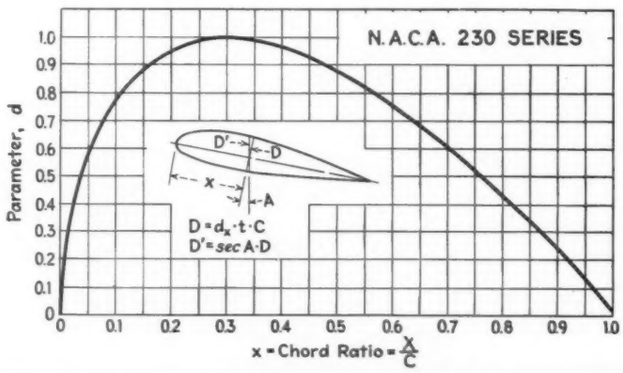


Fig. 2. The airfoil section depth for the N.A.C.A. 230 series airfoils.

Geometric Airfoil Characteristics

(*Continued from page 73*)

in this manner may even be somewhat better than the arbitrarily faired variety for it has been found that the arbitrary variety often have abrupt thickness ratio variations, a fact which may to some measure account for peculiarities in lift distributions in the vicinity of the tip.

For detailed work, such as tip fairing, large scale ordinate charts which can be read within lofting accuracy are required. These may be derived by first lofting a series of airfoils throughout the thickness ratio range by the usual method of laying out about the mean camber line. The values to be plotted may then be obtained by measurement perpendicular to the chord line at the usual stations.

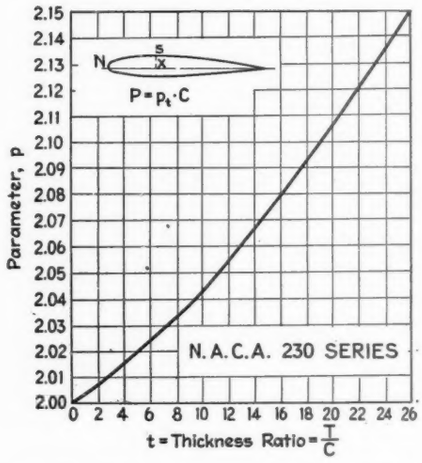


Fig. 3. Chart for determining the airfoil perimeter. This is found by multiplying the thickness ratio T/C, the chord and the parameter "p".

In stress and weight calculations it is often necessary to know the total airfoil depth at some odd chord location. Depth is simply the product of a parameter, the thickness ratio, and the chord as shown in Figure 2. The sum of the upper and lower ordinates, which represents the depth for any given station, is a simple function of the thickness ratio and chord, even though the airfoil ordinates, upper or lower, are not a direct function of the thickness ratio and chord (as indicated in Figure 1). Figure 2 is therefore valid without any adjustment for thickness variations, at least within the range of practicable accuracy.

In aerodynamic calculations it is often desirable to accurately obtain the wetted areas of the airplane. Wetted areas for the wing may be ascertained once the perimeters of a series of wing stations are known. The airfoil perimeter, like the depth, is merely the product of a parameter, the thickness ratio, and the chord as is given in Figure 3. Figure 3 may be augmented for the calculation of partial perimeters (as for skin weight calculation) by separately plotting, for upper and lower surfaces, the ratio: NS/NX (from inset Figure 3) against chord ratio, x, for integral values of thickness ratio. Partial perimeters for odd thickness ratios may then be obtained by extrapolation, and thus the surface distance between any two points on any airfoil of the series may be found.

In stress calculations the torque area defined by the airfoil contour and the spars must often be known. These may be determined from Figure 4 which shows the airfoil section area to be a product of a parameter, the thickness ratio squared and the chord. The area chart eliminates needless planimetering of layouts, and in addition provides a quick method of determining available fuel capacity for built-in wing tanks. Tank capacity is found by plotting section area against span and integrating for volume. True capacity is then obtained by suitably deducting for leak proofing, baffles, etc. In these deductions Figures 2 and 3 are used.

Figure 5 provides an approximate method for calculating airfoil moments of inertia. The primary value of the moment of inertia chart is in determining maximum stresses in solid wind tunnel models and for stressing semi-monocoque wings having appreciable skin thickness such as would be encountered in plywood wings. In the case of the hollow airfoil sections the chord and thickness of the inner airfoil must be calculated so that the desired skin thickness is obtained. The curve given in Figure 5 provides moment of inertia values around the chord line of the N.A.C.A. 00 series, and hence will tend to give slightly conservative values for the 230 series. The use of Figure 5 is not recommended where great accuracy is desired.

References

Reference I

N. A. C. A. Technical Note No. 567—"Tests of N. A. C. A. Airfoils in the Variable Density Wind Tunnel. Series 230" by E. N. Jacobs and R. M. Pinkerton.

Reference II

N. A. C. A. Report No. 460—"The Characteristics of 78 Related Airfoil Sections from Tests in the Variable Density Wind Tunnel" by E. N. Jacobs, K. E. Ward and R. M. Pinkerton.

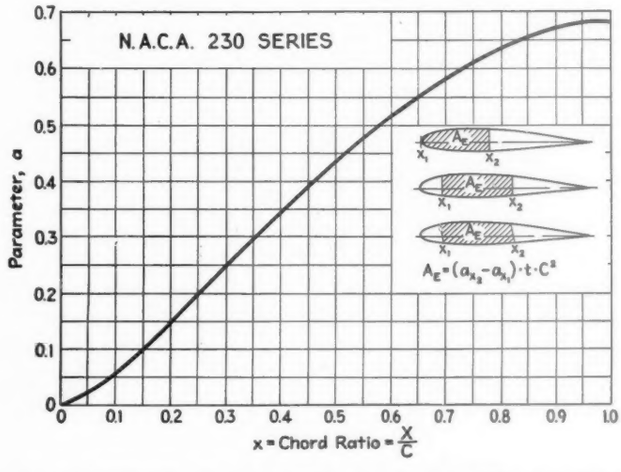


Fig. 4. Chart for determining the torque area. This is a product of the thickness ratio squared, the chord, and a parameter "a".

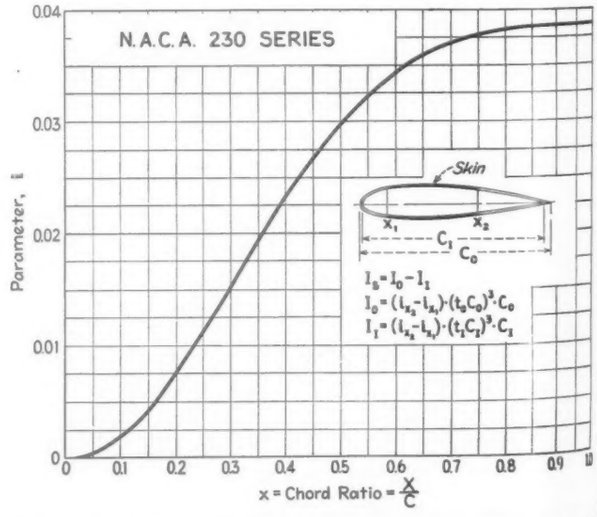

N.A.C.A. 230 SERIES
Parameter, i
0.04
0.03
0.02
0.01
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
x = Chord Ratio = X/C
Skin
$I_S = I_0 - I_1$
$I_0 = (i_{x_2} - i_{x_1}) \cdot (t_0 C_0)^3 \cdot C_0$
$I_1 = (i_{x_2} - i_{x_1}) \cdot (t_1 C_1)^3 \cdot C_1$

Fig. 5. Chart for calculating, approximately, airfoil moments of inertia.

Charting Stability in Aircraft

PART I — In this first part of an article on dynamic stability are presented charts and their equations concerning lateral motions of an airplane. Longitudinal stability will be dealt with in a later issue.

By CORTLAND D. PERKINS

AN interesting development of the graphical solution for aircraft dynamic stability has been developed which enables one to visualize more clearly just how certain changes in aerodynamic qualities will affect both the airplane's lateral and longitudinal dynamic motion in power-off, uncontrolled flight.

This development is an extension of the work the National Advisory Committee for Aeronautics presented in reports on Dynamic Stability written by C. H. Zimmerman. These reports were published several years ago and developed simple chart methods for predicting aircraft dynamic stability in uncontrolled power-off flight. The results obtained in these reports are of great value, but it is felt that a method for presenting the results of different parameter variations in some detail would be of value to the student of aircraft dynamic stability.

The mathematical development of the equations necessary for the solution of the aircraft's motion will not be gone into here, as this can be found in great detail in the literature. The equations will be presented only to enable those not familiar with the theory to use the chart developed herein.

In analyzing either lateral or longitudinal motions, the designer is interested in whether the airplane, when disturbed from free flight, will diverge from the trim condition with no tendency to return, or whether it will oscillate about the trim condition. If it does oscillate, he is interested in the period of the oscillation and the damping. The designer is also concerned with the problem of how certain changes in a given airplane will affect these tendencies. It is a well known fact that the lateral motion of the airplane usually consists of a divergence generally termed "spiral instability" and an oscillation of short period and fair damping. The longitudinal motion, on the other hand, consists of two oscillations, one of short period with heavy damping, and one of long period with very weak damping. A picture then of the divergent, convergent, or oscillatory tendencies of the airplane should be useful to the designer, and it is a method for developing this picture that will be presented here. The first part of this article will have to do with lateral stability while longitudinal stability will be discussed later.

This method, as was mentioned before, is an outgrowth of the graphical solution of the stability quartic, developed from the equations of motion of the airplane in uncontrolled, power-off flight. The brief development of this method of solution will be presented to clarify the problem.

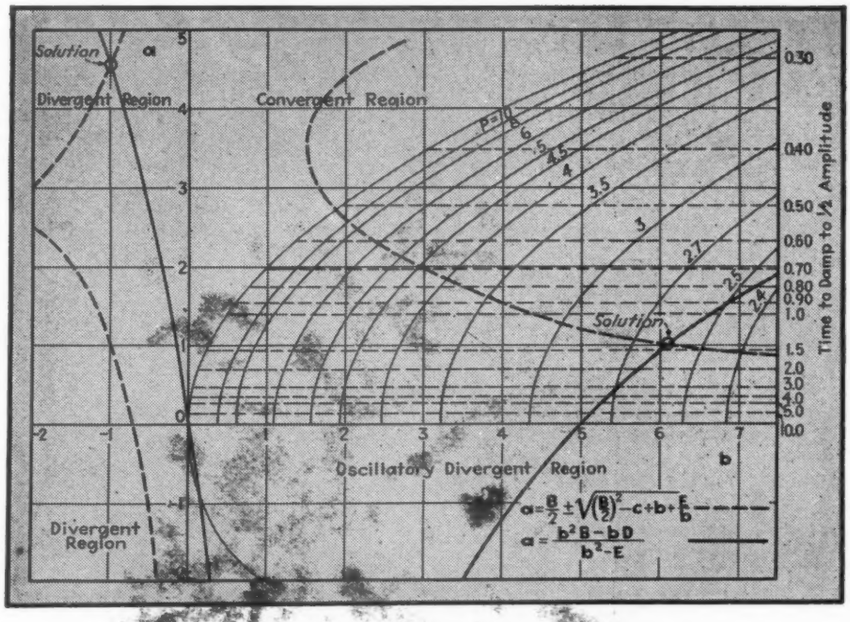


Fig. 1. Basic chart showing lines of constant damping and constant period in non-dimensional units.

The variation of each component of the lateral motion varies with time according to:

v, p, or $r = C_1 e^{\lambda_1 t} + C_2 e^{\lambda_2 t} + C_3 e^{\lambda_3 t} + C_4 e^{\lambda_4 t}$
where λ_1, λ_2, λ_3, λ_4 are roots of the quartic
$A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$

The coefficients of this quartic are functions of the non-dimensional stability derivatives as follows:

$$A = 1$$

$$B = -(y_v + n_r + l_p)$$

$$C = l_p n_r - l_r n_p + y_v(l_p + n_r) + \mu n_r$$

$$D = y_v(l_r n_p - l_p n_r) + \mu l_r\left(n_p - \frac{C_L}{2}\right) - \mu n_r\left(\frac{C_L}{2}\tan\gamma + l_p\right)$$

$$E = \mu\frac{C_L}{2}(l_r n_v - l_v n_r) + \mu\frac{C_L}{2}\tan\gamma\,(l_p n_v - l_v n_p)$$

where

$$y_v = \tfrac{1}{2}\frac{dC_y}{d\beta}$$

$$n_v = \tfrac{1}{2}\left(\frac{b}{k_z}\right)^2\frac{dC_n}{d\beta}$$

$$l_v = \tfrac{1}{2}\left(\frac{b}{k_z}\right)^2\frac{dC_l}{d\beta}$$

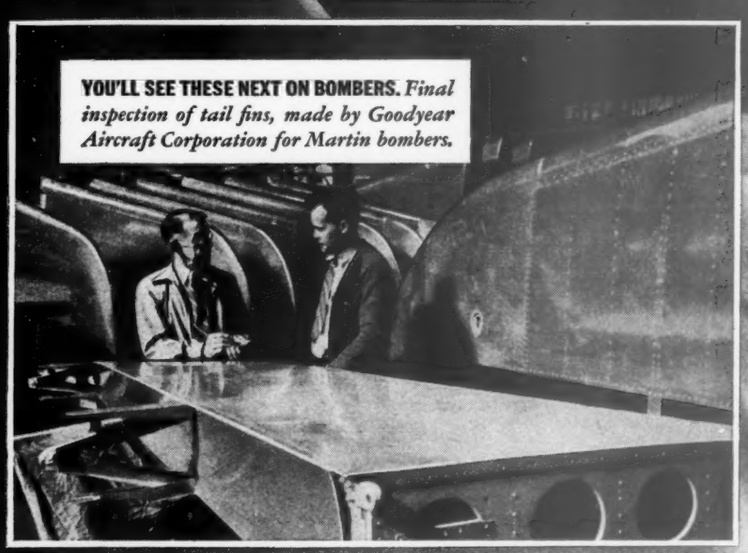
$$l_p = \tfrac{1}{4}\left(\frac{b}{k_z}\right)^2\frac{dC_l}{d\left(\frac{pb}{2v}\right)} = -\frac{1}{10}\left(\frac{b}{k_z}\right)^2$$

$$n_p = \tfrac{1}{4}\left(\frac{b}{k_z}\right)^2\frac{dC_n}{d\left(\frac{pb}{2v}\right)} =$$

(Turn to page 78)

America must be

first in the a



YOU'LL SEE THESE NEXT ON BOMBERS. *Final inspection of tail fins, made by Goodyear Aircraft Corporation for Martin bombers.*

he air!

THE conviction that this nation must be mistress of the skies is no new thing here at Goodyear. For more than thirty years we have been intimately associated with the advancement of *all* branches of aeronautics — in the belief that aerial transportation was destined to play a commanding part in world affairs.

This is being emphatically confirmed wherever war is waged today. From the events since December 7th one solemn fact stands out as a warning to us all. *Unless and until America is the most powerful nation in the air, our safety, our freedom, and our standard of living will not again be what they have been in the past.*

Today as our country builds toward unchallengeable might in the air, Goodyear is proud that its long years of aeronautical experience fit it for an important share of this great effort. From our four huge aircraft parts factories an ever-increasing volume of airplane wing and tail units, control surfaces, flight control cabins, wing floats and fuselage sub-assemblies flows to airplane assembly lines.

Until America has achieved mastery in the air, this work has precedence over all our other activities. We think you would have it so.

P. W. Litchfield

President,
Goodyear Aircraft Corporation

GOODYEAR
AIRCRAFT

Charting Stability

(*Continued from page 75*)

$$-1/32\left(C_L - 1.1\frac{dC_{D_w}}{d\alpha}\right)\left(\frac{b}{k_z}\right)^2$$

$$l_r = 1/4\left(\frac{b}{k_z}\right)^2 {}_d\left(\frac{dC_l}{d\left(\frac{rb}{2v}\right)}\right) = \left(\frac{b}{k_z}\right)^2 C_L$$

$$n_r = 1/4\left(\frac{b}{k_z}\right)^2 {}_d\left(\frac{dC_n}{d\left(\frac{rb}{2v}\right)}\right) = 1/4\left(\frac{b}{k_z}\right)^2$$

$$\left(-\frac{C_{D_w}}{3} - 2\eta_t\frac{l^2}{b^2}\frac{S_t}{S}\frac{dC_{L_t}}{d\beta}\right)$$

The stability derivatives are:

y_v	Lateral force due to sideslip derivative
n_v	Yawing moment due to sideslip derivative
l_v	Rolling moment due to sideslip derivative
l_p	Rolling moment due to rolling derivative
n_p	Yawing moment due to rolling derivative
l_r	Rolling moment due to yawing derivative
n_r	Yawing moment due to yawing derivative

where

β	angle of sideslip
p	rolling velocity radians/sec.
r	yawing velocity radians/sec.
l	length from c.g. to center of pressure of vertical surface
b	wing span
k_x	radius of gyration about longitudinal axis
k_z	radius of gyration about vertical axis
S	wing area
S_t	vertical tail area
η_t	tail efficiency
C_{D_w}	drag coefficient of the wing only
C_l	rolling moment coefficient
C_n	yawing moment coefficient
C_y	sideforce coefficient
C_L	lift coefficient
C_{L_t}	lift coefficient of the tail

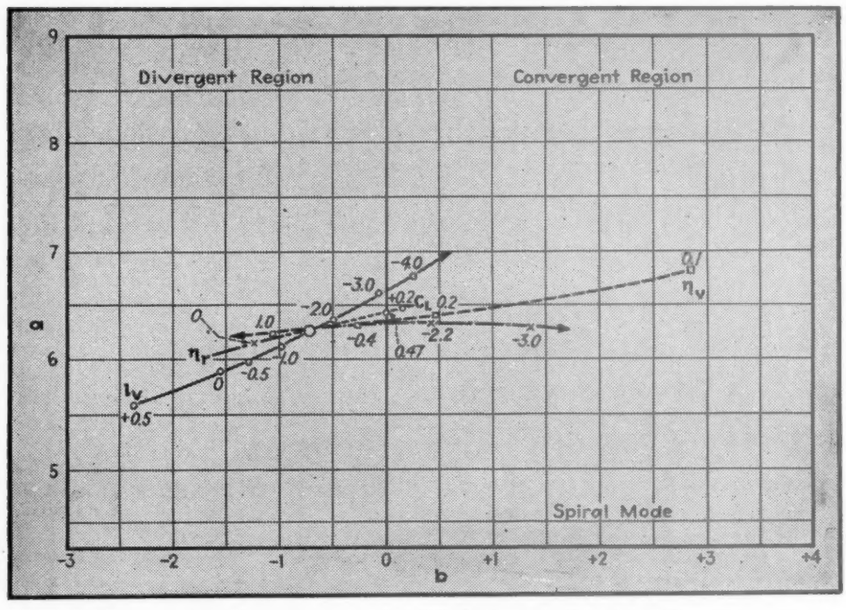


Fig. 2. Parameter changes affecting spiral stability.

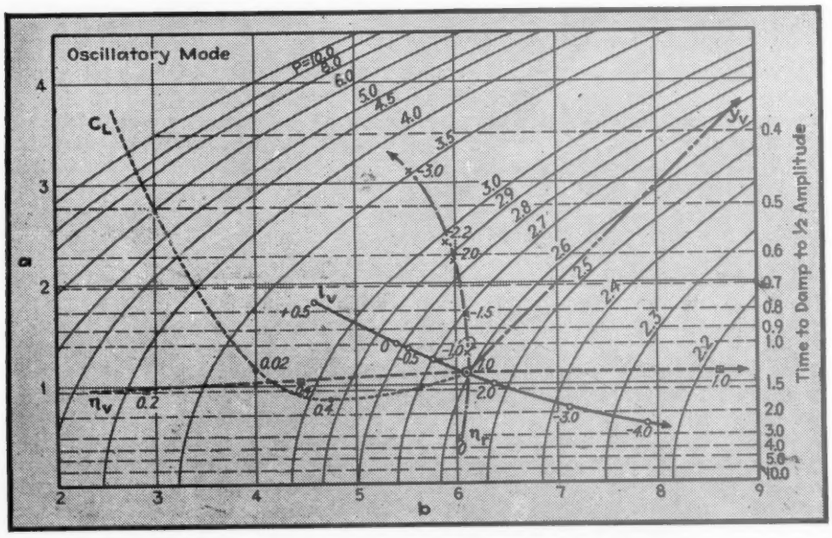


Fig. 3. Parameter changes affecting lateral oscillation.

The values of the stability derivatives n_v, l_v and y_v can be obtained from any modern wind tunnel while the derivatives l_p, n_p, l_r and n_r can not be determined in the present day wind tunnel. It is therefore necessary to compute them from equations based on theory and experience.

GRAPHICAL METHODS

One of the best ways of solving a quartic is the graphical method. We assume that the quartic can be split up into two quadratics $(\lambda^2 + a_1\lambda + b_1)(\lambda^2 + a_2\lambda + b_2) = 0$. By expanding the two quadratics and equating coefficients with the quartic we obtain

$$A = 1$$
$$B = a_1 + a_2$$
$$C = a_1 a_2 + b_1 + b_2$$
$$D = a_1 b_2 + a_2 b_1$$
$$E = b_1 b_2$$

solving in terms of a and b, we get

$$a = \frac{B}{2} \pm \sqrt{\left(\frac{B}{2}\right)^2 - C + b + \frac{E}{b}}$$

and

$$a = \frac{b^2 B - bD}{b^2 - E}$$

Plotting these equations for values of a and b, we get curves, the two intersections of which give the values of $(a_1\ b_1)$ and $(a_2\ b_2)$ which when substituted into the quadratics yield the solutions

$$\lambda = -\frac{a_1}{2} \pm \sqrt{\left(\frac{a_1}{2}\right)^2 - b_1}$$

$$\lambda = -\frac{a_2}{2} \pm \sqrt{\left(\frac{a_2}{2}\right)^2 - b_2}$$

These are the four roots sought for, and the nature of the motion can be immediately determined from them. If $\sqrt{\left(\frac{a}{2}\right)^2 - b}$ is imaginary the motion is an oscillation which damps if a is positive, is neutral if $a = 0$, and is negatively damped if a is negative. If the radical is real there will be no oscillation. The quadratic can then have two roots, one positive and one negative, two positive or two negative. If the quadratic has any positive root the motion will be divergent. If a is positive and the radical real, then when b is positive both roots will be negative and the motion will converge, while when b is negative the motion will diverge. If a is negative, the motion will diverge. If

a is negative and the radical is real, when b is positive or negative the motion will be divergent.

It has been found that a chart with values of a as ordinates and b as abscissas not only will enable one to solve the quartic graphically but will immediately show the type of motion to be expected, whether convergent or divergent, and if oscillatory, the period and the damping.

We can express the solution as

$$\lambda = x \pm iy$$

where the period in non-dimensional time units

$$P = \frac{2\pi}{y}$$

and the time to damp to $\frac{1}{2}$ amplitude in non-dimensional time units

$$T = \frac{.693}{x}$$

where

$$x = -\frac{a}{2} \text{ and } y = \sqrt{b - \left(\frac{a}{2}\right)^2}$$

On the basic chart of values of a and b we can immediately plot curves of constant period and damping.

$$P = \frac{2\pi}{\sqrt{b - \left(\frac{a}{2}\right)^2}} \qquad T = \frac{.693}{\frac{a}{2}}$$

As mentioned before when a is positive and the radical equals zero, we have the equation of the curve separating the convergent region from the region of decreasing oscillations.

$$\sqrt{b - \left(\frac{a}{2}\right)^2} = 0 \text{ or } a^2 = 4b$$

The region between this curve and the b axis is the region of decreasing oscillations. The area between the negative branch of this curve and the b axis is the region of increasing oscillation. The area between the positive branch of the boundary curve and the a axis is the region of pure convergence while all other areas are divergent regions in increasing severity as one swings from the second quadrant through the third into the fourth up to the negative branch of the oscillatory boundary.

These regions are plotted on the stability chart. The two equations involving a and b are plotted and their intersections found, the point of intersection showing immediately what are the stability characteristics. Curves of constant period are parabolas about the b axis, while curves of constant damping are straight lines parallel to the b axis. It will be noticed that the damping is improved as one moves away from the b axis and that the period increases as one approaches the outer boundary.

The basic chart is shown in Fig. 1. Lines of constant damping and constant period are shown in non-dimensional time units. To convert to seconds it is necessary to multiply by the time constant $\tau = \frac{m}{\rho S V}$. The regions of convergence, divergence and oscillations are shown which enables one to tell the type of motion immediately on obtaining a solution. A typical solution of the lateral motion is shown for an assumed airplane, trimmed to a lift coefficient of $C_L = 1$ and having the following stability derivatives:

$$\begin{aligned} y_v &= -.14 \\ l_v &= -1.5 \\ n_v &= .64 \\ n_p &= -0.5 \\ l_r &= 4.0 \\ n_r &= -0.8 \\ l_p &= -6.4 \end{aligned}$$

The graphical solution is shown on the chart in Fig. 1. It can be seen that there are two intersections which give the four roots necessary. One solution is in the divergent region and shows that the airplane will be spirally unstable. The other solution is in the oscillatory range and has a period of 2.6 units and the motion damps to one-half amplitude in 1.39 units. If our assumed airplane has a wing loading of 40 lb./sq.ft. the time constant will be 1.8. Therefore

$$P = 2.6 \times 1.8 = 4.68 \text{ seconds}$$
$$T = 1.39 \times 1.8 = 2.50 \text{ seconds}$$

To depict how the lateral motion varies with changes in the stability derivatives most easily controlled by the designer, y_v, l_v, n_v, and n_r were varied one at a time and the new solutions plotted in sequence. Sections of the chart are used for each solution variation. Fig. 2 shows how these parameter changes affect the spiral stability and Fig. 3 shows how they affect the lateral oscillation.

It can be seen from these plots that the following are the effects on this airplane of these derivative changes:

1. l_v

Increasing the rolling moment due to sideslip reduces the spiral instability gradually until at a point where $l_v = -.31$ the airplane becomes spirally stable. At the same time, however, the period of the lateral oscillation is decreased and the time to damp to one-half amplitude is increased.

2. n_v

An increase in the yawing moment due to sideslip shortens the period and leaves the time to damp to one-half amplitude about the same. It also increases the spiral instability of the airplane considerably. The chart shows that a reduction in n_v will increase the period materially and will make the airplane tend toward spiral stability.

3. n_r

An increase in the yawing moment due to yawing will make the airplane more spirally stable, and at the same time will increase the period and damping of the lateral oscillation.

4. y_v

Increasing the side force due to sideslip has little effect on the period but improves the damping. It has little effect on the spiral stability.

These trends were plotted for the airplane trimmed at a lift coefficient of $C_L = 1$. The trend of stability for a reduction of lift coefficient is shown. As the airplane is trimmed for higher speeds the period will increase and the damping will improve. The airplane will tend to become spirally stable at a lift coefficient of $C_L = .47$.

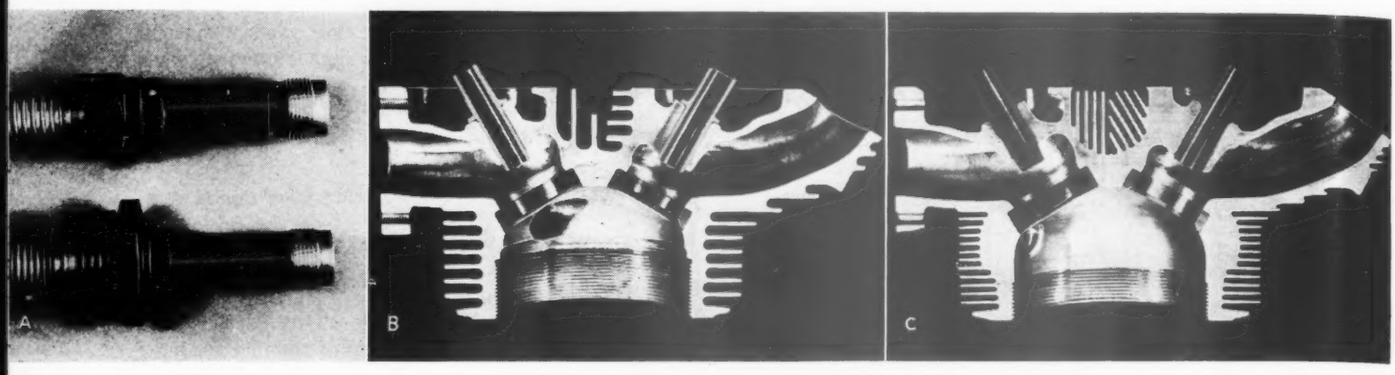
It is felt that an airplane to have satisfactory lateral stability characteristics need not be spirally stable. This instability however should not be viscous. The lateral oscillation is the most important characteristic of the motion due to its inherent short period and rather poor damping which allows control lag to couple with the motion to introduce negative damping under certain conditions. The oscillation should be either of long period so as to allow good positive control damping, or of short period with heavy damping. The possibility of obtaining a long period is rather remote, as is seen by the chart. The only parameter change that can give a longer period is a reduction in n_v. This reduction, however, produces other serious difficulties, such as poor aileron effectiveness, so it must be ruled out. The other alternative, of the short period and heavy damping, is the best way out. The chart shows that the best derivative to change for this is n_r. An increase in n_r, as is shown, will increase the damping, lengthen the period and make the airplane more spirally stable.

This example demonstrates the way the chart will picture the effects of certain airplane design changes on the lateral motion. The graphical solution involved is easy to handle after a little experience is acquired, and a great many variations can be made in a short period of time.

The chart has been demonstrated for dynamic lateral stability analysis, but is perfectly applicable for dynamic longitudinal stability analysis as well.

The demonstration of the application of dynamic stability charts to longitudinal motion will follow in an early issue of AVIATION magazine.

A standard 9/16-12 HC thread "Heli-Coil" spark plug (left) as compared to a standard metric 18 mm. spark plug below it. Note difference in thread design; the "Heli-Coil" having a a rounded thread instead of the Vee-thread as in the standard metric 18 mm. type. Sectional view (center) showing interior of cylinder head as originally designed using conventional 18 mm. spark plug bushing. A large size cut-out is required in head due to the conventional bushing. Sectional view (right) of redesigned cylinder head using "Heli-Coil" spark plug bushing. Note smaller diameter of cut-out required for bushing which permitted relocation of spark plug to provide increased accessibility.



"HELI-COIL" Spark Plug Bushing

By HAROLD CAMINEZ

Consulting Engineer, Aircraft Screw Products, Inc.

In this article a new type of spark plug bushing is described. Employing a helical coil of precision-shaped spring wire in place of the conventionally threaded solid metal bushing, the "Heli-Coil" bushing has certain differences and advantages.

ALUMINUM cylinder heads are used almost exclusively in modern aircraft engines. This metal, because of its low specific weight, good heat conductivity, excellent fabricating properties and good machinability, has until now proven to be by far the most satisfactory material for this purpose. The one disadvantage of aluminum is its relatively low hardness and cutting resistance, which makes it generally unsatisfactory for threaded connections where frequent disassembly of the thread joint may be required.

To surmount this difficulty, it has long been the practice with aluminum aircraft engine cylinder heads to use hard metal bushings made of bronze for the purpose of providing a suitable thread receptacle for the spark plug. While these conventionally threaded solid metal bushings provide a suitable hard thread surface, they have a number of disadvantages. In the first place, a relatively large hole is required in the head to receive the conventional metal bushing, since this bushing must of necessity be larger in diameter than the spark plug. This larger hole not only weakens the cylinder head but also restricts the choice of location for a spark plug. The location of the spark plug not only determines spark plug accessibility, but also affects engine performance and power. The large spark plug insert is, therefore, particularly undesirable in those cylinders where it adversely influences spark plug location.

Secondly, the bushing must be tightly fitted into the head. This is necessary to prevent leakage past the threads and to obtain a good thermal contact between the bushing and the head. It is also required to insure that the bushings remain in place when the spark plug is removed. If the thread is loosely or poorly fitted, leakage and a poor thermal connection may result. The spark plug will then overheat and may cause detonation with resulting loss in engine power and generally unsatisfactory engine operation. Moreover, the fit must be made so that it will stay tight after continued use. Carbon and corrosion collecting on the exposed electrode end of the spark plug often causes the plug to jam tightly in the bushing thread, so that in removal the bushing may be loosened unless particular care is taken in the initial assembly of the bushing to prevent this. To replace in service a loose bushing of conventional design is a costly operation and quite often the cylinder head must be replaced when such a bushing is loose.

The tight fitting threaded connections

required for the conventional solid metal bushings entail careful and accurate machining of the parts and impose an appreciable stress in the cylinder head at a point where the head is already weakened by the relatively large diameter holes required for the bushings. It is, therefore, necessary—in order to prevent failure of the head through these spark plug bushing holes—to appreciably thicken the cylinder head. The third disadvantage of the conventional solid bushing is then the added weight it entails, not only due to its own weight, but due to the additional thickness required in the cylinder head to take care of the stress involved.

Other objections that may be mentioned with reference to the conventionally threaded bushing is the relatively high cost of the part which results from the very accurate machining required and the care entailed in assembling it in place. These bushings are, moreover, generally made of bronze and there are objections to the use of this material in aluminum cylinder heads. Bronze is used for the bushing because it has good heat conductivity, good machinability and a coefficient of expansion approximating that of aluminum. However, the galvanic action that occurs between the bronze and aluminum may cause corrosion of the aluminum head if the engine should be stored in a damp place. The most serious objection to the use of bronze in high powered engines, however, is the fact that this material is readily attacked by the products of combustion resulting from highly loaded fuel. In operation these products of combustion seem to work in between the fine clearance existing between the spark plug thread and the bushing, and by corroding the bronze, often cause the spark plug to be frozen in place. This makes it difficult to remove the spark plugs after they have been in extended use under high power operation.

The problems of the conventional solid metal bushings have long been recognized, and much research has been expended in the detail design of these bushings, as well as in the matter of fits and methods of installation. Figure 1 shows a typical design of spark plug boss for a modern aircraft engine using a conventional solid metal bushing.

In order to avoid the expenses entailed with the use of the conventional solid metal bushings, some of the less expensive engines have been made with spark plugs screwed directly into the aluminum cylinder heads. To minimize wear in the aluminum thread, spark plugs used in these heads are specified to have threads with a very fine surface finish. In general these spark plug connections have proved inadequate. Despite the fine finish on the spark plug thread, carbon and corrosion accumulate on the end of the spark plug thread exposed to the combustion gases. When the spark plug is removed, which it must be at regular intervals for cleaning, adjustment or replacement, the unbushed thread in the aluminum is worn. This condition gets progressively worse with use until the danger of thread stripping makes it necessary to remove the cylinder from use, and to bush up the thread. The rebushing of an aircraft cylinder spark plug thread is a precision operation, generally requiring that the cylinder be sent back to the factory for correction. With the unbushed thread it is also possible for a mechanic to damage the thread in the cylinder when screwing the spark plug into place. Should such damage go unnoticed, or should a spark plug be assembled into an excessively worn thread, a condition is set up which may allow the spark plug to be blown out of the cylinder head. If this should occur, a serious fire hazard arises, it is necessary to stop the engine, and in flight a forced landing is entailed. The use of the unbushed thread, therefore, requires that the inspection personnel exercise special care when inspecting spark plug fits. In general, engine operators would rather pay the added cost required for the properly fitted bushing than to run the risk involved with the use of the unbushed cylinder.

Several years ago the Aircraft Screw Products Company, Inc. set out to develop an improved spark plug connection for use in aluminum alloy cylinder heads such as are employed in aircraft and similar high duty engines. After many months of testing to determine the proper sizes, fits, material and manufacturing methods, the company developed the "Heli-Coil" spark plug bushing. This spark plug connection employs a helical coil of precision-shaped spring wire in place of the conventionally threaded solid metal bushing previously described. Figure 2 shows a cross section through an aircraft cylinder spark plug using a standard helical coil spark plug bushing.

The helical coil bushing has certain distinct differences from the solid metal bushing. In the first place the shape of the wire section and the design of the coil is such that the helical coil bushing is self-locking in place. Therefore, when it is assembled in the tapped hole it need not exert any high stress in the aluminum to insure its remaining in position. The need for tight fits and for pinning the bushing in place is thereby avoided. Secondly, a land is provided between the thread in both the tapped hole and on the spark plug which permits some direct contact between the spark plug shell and the aluminum head. All the heat flow from the spark plug, therefore, need not go through the bushing since an appreciable amount is conducted directly to the head through these lands. In the third place, the tapped hole for the helical coil need be only slightly greater in diameter than the diameter of the spark plug thread which allows the hole size in the cylinder head to be relatively small.

A comparison between the conventionally threaded solid metal spark plug bushing used with a standard 18 mm. spark plug and a "Heli-Coil" spark plug bushing used with the standard 9/16-12 HC thread spark plug is shown in Figs. 1 and 2. The former figure shows the standard 18 mm. spark plug originally

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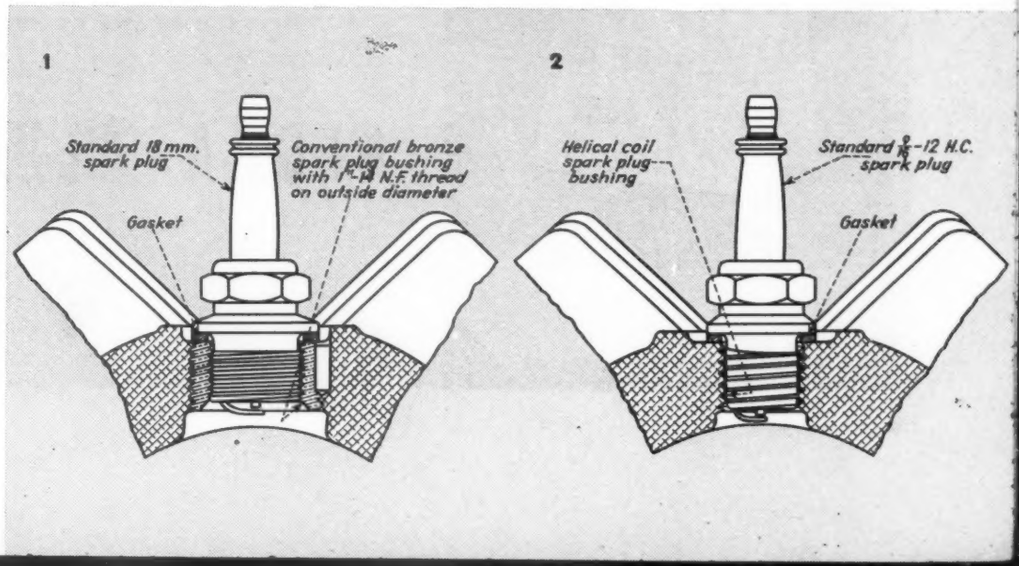
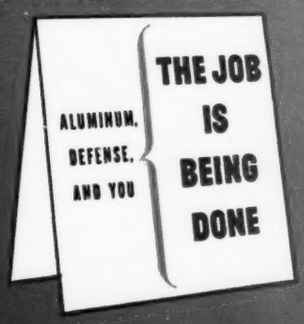


Fig. 1 — Typical design of spark plug boss using conventional solid metal bushing for the spark plug.

Fig. 2—Cross section through an aircraft spark plug using a standard "Heli-Coil" bushing.

WHAT 5¢ CAN MEAN TO YOUR FUTURE



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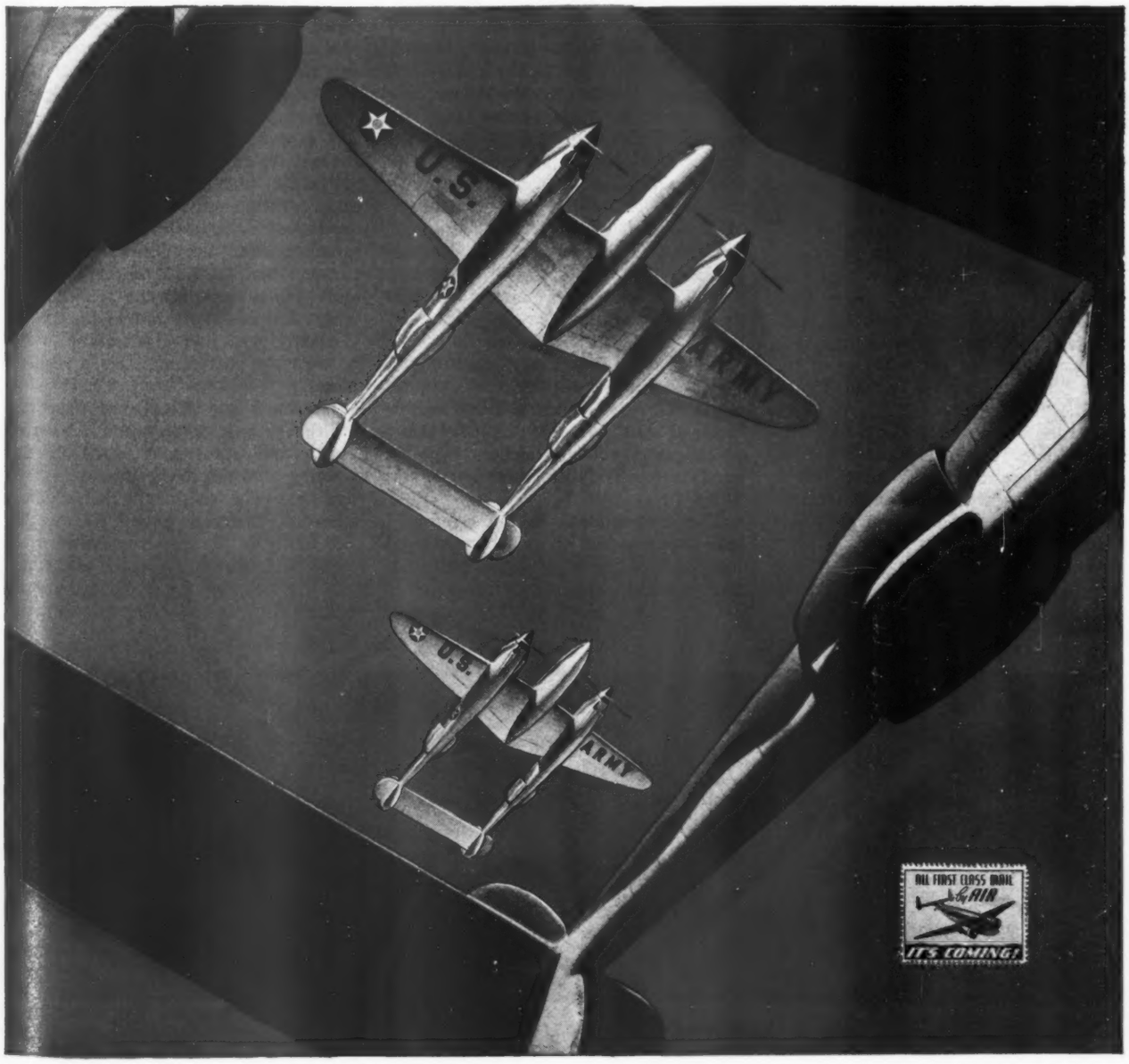


Synthetic Resins In

By H. N. HAUT
Bellanca Aircraft Corp.

PART I. This is the first of two articles explain craft structures. In this part the background for

THE principal interest of engineers and manufacturers of aircraft today, especially in the light of the present national defense program, is the structural application of plastics. The importance of any developments which will increase production, improve the product, reduce costs or weight, or reduce the percentage of highly skilled labor required, can hardly be over-emphasized, and it is undeniable that these advantages go hand in hand with plastics.

Most progressive manufacturers are either investigating the possibilities of applying plactics to their product or are keenly on the lookout for favorable signs of progress. Investigations are taking the form of actual construction of component parts, varying in importance from elevator tabs and bomb bay doors, to complete wing and fuselage structures. Again the types of resins are unrestricted, covering a variety of both thermoplastic and thermosetting resins, as well as a number of fabricating processes. It is a notable and healthy sign that most of the work is being done in close collaboration with competitive resin manufacturers, for only with their intimate knowledge of the behavior of the resins can true progress be made by the airplane manufacturers.

In order to fully comprehend the progress to date and the definite trends in plastics construction, we must review briefly the research work and literature and examine the properties of the resins as an aircraft material.

At the outset, it was rocognized that the pure synthetic resins lack the strength, toughness and resilience to be applied as structural materials as they are, and it was obvious that a reinforcing medium was needed. Moreover, it was recognized that the reinforcement could not be introduced as a filler of flour or macerated canvas, or as an alloy in metals since the amorphous character of the material could hardly be improved that way.

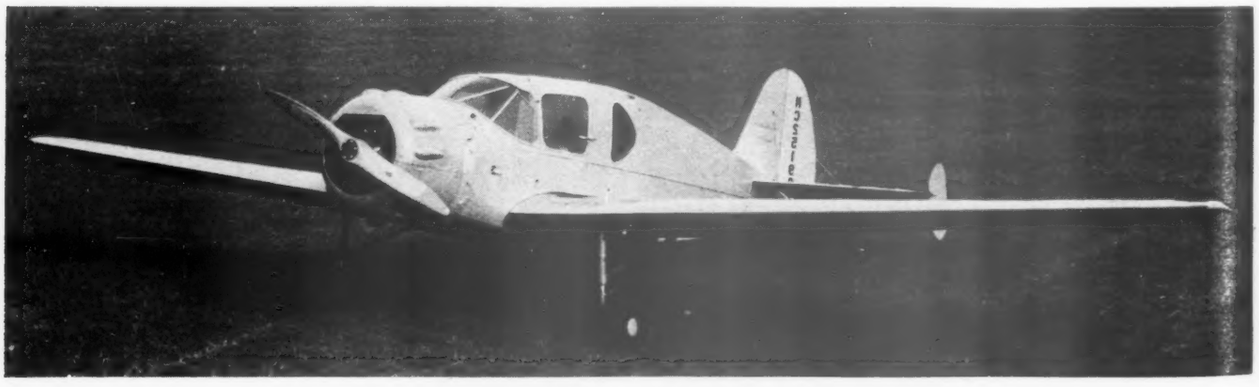
DeBruyne[1] worked primarily with long reinforcing fibres, such as cotton, silk, flax and hemp, by packing the fibres tightly together and using just enough phenolic resin to fuse them together. By this method, tensile strength of well over 100,000 lb, per sq. inch were obtained with specific gravities not exceeding 1.55. He also found that by applying an initial load to the fibres during the moulding operation, the modulus of elasticity could be substantially increased. If we use as an index of structural efficiency the ratios of strength over specific gravity and elastic modulus over specific gravity, it is seen that the tensile efficiency far exceeds that of the metals and wood. However, this type of construction has no appreciable effect on the compressive strength, which increases but little over the pure resin. Obviously then, the use of this material was seriously limited. Other investigators, notably Reichers[2], reported similar results with other vegetable fibres.

The conventional fabric reinforced laminated material previously mentioned has found a variety of uses in aircraft, but structurally is characterized by a low modulus of elasticity compared with other materials, and this lack of stiffness has been the primary obstacle to its structural use. As early as 1924, propellers moulded from tough, strong materials of this nature were actually built and flown, but have since faded from the market. It is suspected that the lack of stiffness may have been a contributing cause.

Although the persistently low modulus of elasticity may have impeded its progress structurally, its other virtues of toughness, strength and water resistance have made it a very desirable product, so much so that it has recently appeared as a completely formed subcontrol surface of approximately one square foot area, and by now is probably in production on one of our well known airplanes.

Probably the most significant of the early development work has been in cosnection with the use of wood as a reinforcement for the plastics. It is a paradox that the bulk of the literature and earlier experimental work comes from Europe, notably England and Germany, who find it necessary to import a large part of their wood requirements.

Kraemer[3] and King[4] have reported on the properties of wood reinforced resins and subsequent work in this country confirms, to a great extent, their findings. The basis of the unusual affinities these materials have for each other lies firstly in the disparity between the tensil and compressive strength which is a characteristic of wood, and the inverse difference in the resins. Sitka



Bellanca's "Cruisair" resin bonded plane.

In Construction

ing the development of synthetic resins for air- modern wood construction is given.

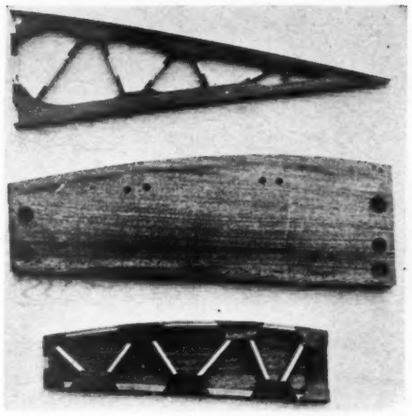
spruce, for example, is much higher in tensile than compressive strength and a phenolic resin on the other hand is much stronger in compression than tension. Obviously, a combination of the two should result in vastly improved and more nearly balanced properties. And so it does. The improvement is further enhanced by the natural adhesive properties of the resin.

The combining of wood and resin to produce the improved product is ordinarily accomplished in one of two ways, either by simply laminating the thin veneers with a resin adhesive of the liquid or film type, under heat and pressure, or by first impregnating the veneers with resin by soaking, vacuum or pressure methods and then applying the necessary heat and pressure to complete the polymerization cycle of the resin. In either case, the increase in strength is accompanied by an increase in density. It is noteworthy that the increase in density is influenced by both the pressure employed, and by the percentage of resin in the construction, the resin having a higher density than the wood. A study of reports[5] on these various constructions indicates that the density increase which is due primarily to pressure increases the tensile strength at a greater rate than the compressive strength while the density increase due to the higher resin percentage increases the compressive strength at a greater rate. It is obvious, then, that by suitable manipulation of the variables, a wide variety of physical properties and densities may be had within the limits of the material.

A specific example would be the values reported by Tiltman[5] and Ellison[5] of birch laminations impregnated and compresed to a specific gravity of 1.0. The construction yielded a tensile of 22,000 lb. per sq. inch, and a compressive strength of 21,000 lb, per sq. inch. Bernhard,[5] Perry[5] and Stern[5], on the other hand, laminated and compressed birch specimens to a specific gravity of 1.05 without impregnation with a resulting tensile of 19,000 lb. per sq. inch and compression strength of only 11,700.

Another variation of this process is the differential impregnation of wood in which the density of the board is varied from one end to the other by progressively restricting the amount of resin absorbed. The same result may also be accomplished by differential pressure. Visualize a pile of veneers between two parallel planes which are press platens. If the pile is thicker at one end than the other, the pressure will be greater at the thicker end, and the density correspondingly higher.

The advantages of differential impregnation have already been exploited in Europe in the fabrication of propellers. The particular benefit residing in the characteristic stress distribution along the blade.

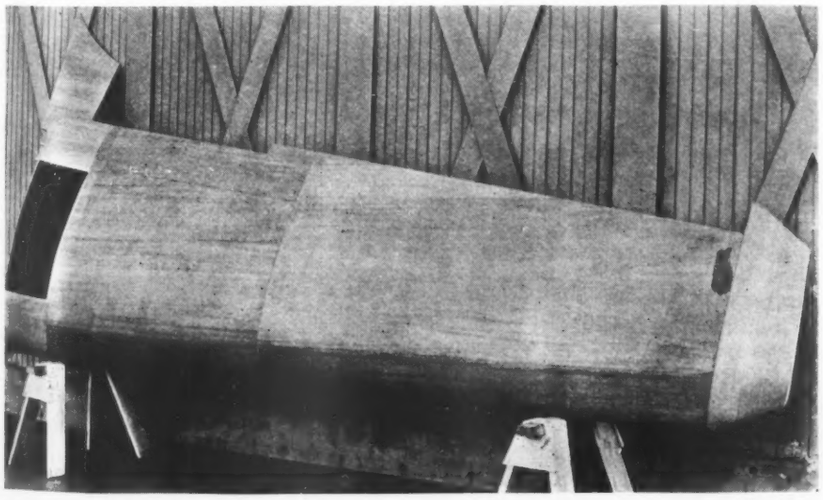


Typical phenolic resin bonded rib construction.

Extremely high stresses are encountered at the hub section, tapering off to zero at the tip and any excess weight especially near the tip is magnified by centrifugal force and translated into higher stresses at the hub.

Efforts to obtain these differential materials from manufacturers in this country have thus far proved fruitless, but some progress has nevertheless been made by using the highly densified wood at the hub section and splicing to it wood of a lower density, with heat reactive synthetic resin adhesives.

Complete descriptions of the working characteristics and physical properties of the laminated and impregnated materials may be found in the literature[4,5] accompanied by comparisons with more conventional structural materials and discussion of their relative merits in airplane structures, but comparatively little of it has actually been used. The average airplane manufacturer has been found very open minded and willing to exploit the new materials, but actually very little can be done with a small block in a glass case, so to speak, and until structural sizes are available, advancement will necessarily lag.



A Wing panel of the Bellanca Model 14-9 Cruisair, bonded with low temperature phenolic resin.

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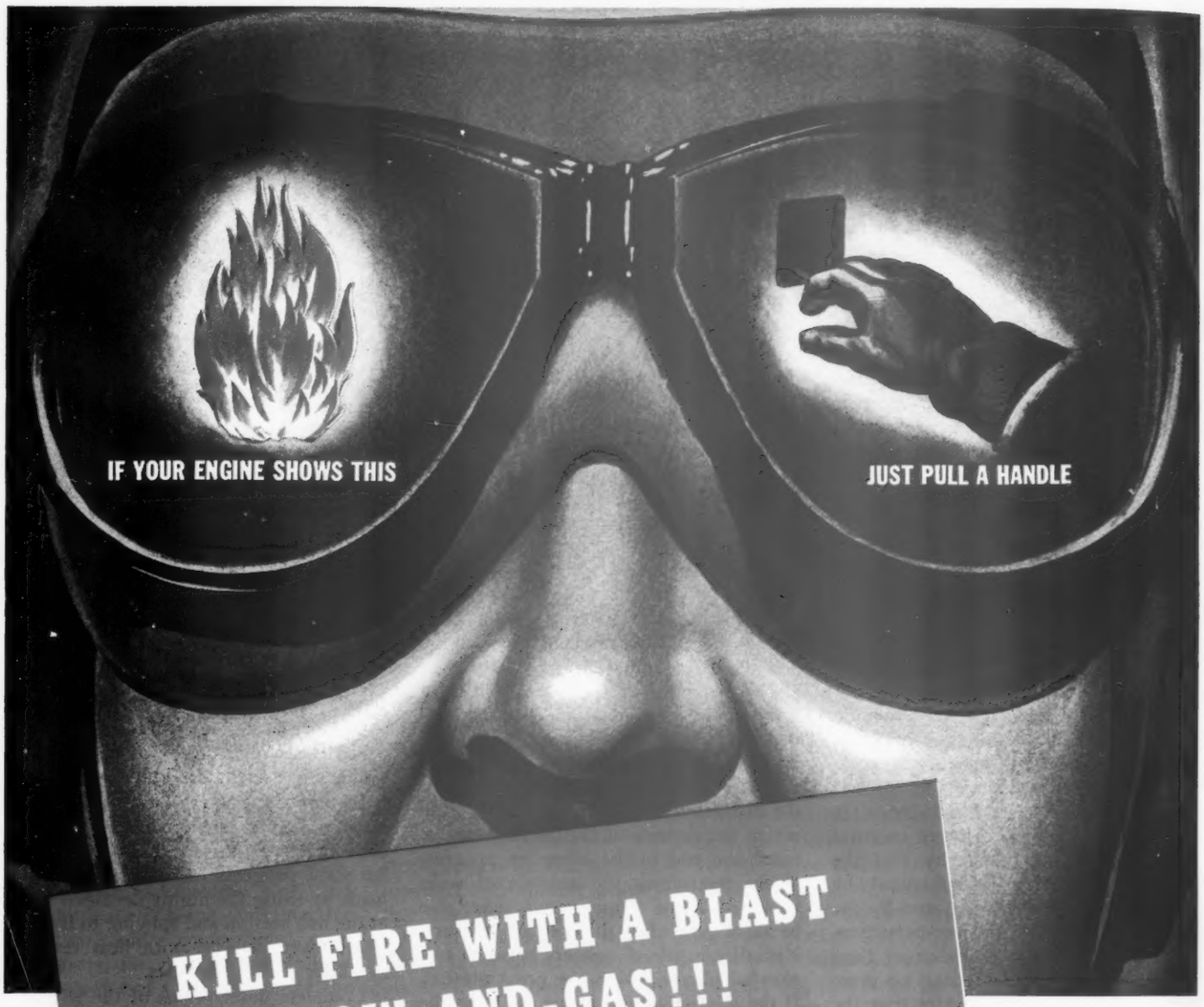


KILL FIRE WITH A BLAST OF SNOW-AND-GAS!!!

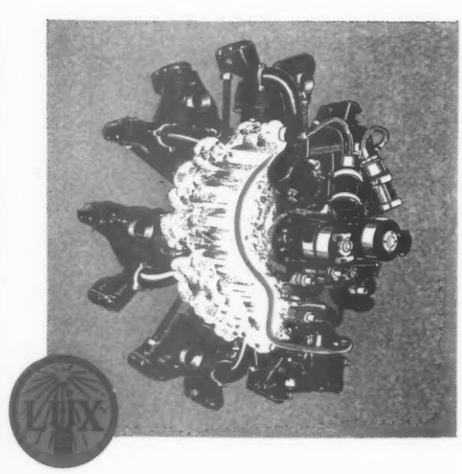
A FLASH of flame . . . or a wisp of smoke. An easy pull of a handle. A rushing cloud of carbon dioxide snow and gas. *Out goes the fire!*

It's as simple as that—and quicker than it takes to tell—to kill engine fires in the air, or on the ground, with the LUX Built-in Extinguishing System!

It's the system that *controls, releases* and *directs* the tremendous fire-killing power of LUX carbon dioxide gas—aviation's quickest extinguishing agent. LUX kills fires in 3 or 4 seconds! Yet it hurts nothing but fire. Clean, dry, it's harmless to engine, plane, and equipment.

LUX flame detectors, teamed with the Built-in LUX System, may be used as the actuating element of a completely automatic fire fighting unit. There are LUX Systems for "in-line" as well as radial engines, multimotor as well as single-motor planes.

The booklet "White Magic" tells the whole story about LUX Built-in fire protection for planes. It's free. Write for it.



Walter Kidde & Company, Inc., 322 West Street, Bloomfield, N. J.

Dynamometers for Testing Engine Ratings

By P. G. LESSMAN
Transportation and Generator Division, Westinghouse Electric & Mfg. Company

The present national emergency has led to the development of large, high speed internal combustion airplane engines and a demand for testing methods having unusual characteristics. This demand has resulted in the development of large combination cradle-type dynamometers for laboratory work. Such machines consist of an eddy current absorption brake and a d.c. unit which can be used for either absorption or for motoring during friction load tests.

Some recently built combination dynamometers, the largest units of their kind, have an absorption rating of 4000 hp. at 700/2000 rpm. Absorption capacity is 3200 hp. for the eddy current brake and 800 for the d.c. unit. The d.c. machine, with a motoring capacity of 700 hp., is equivalent in physical size to a machine having an absorption capacity of 2000 hp. at 2000 rpm. Extreme sensitivity, accuracy within .5 percent of scale capacity, has been achieved by supporting the stators in ball bearing trunnions with three race ball bearings which permit rotation of the intermediate race. Static friction has been reduced about 50 percent. Sleeve bearings for the rotor of the d.c. unit with a ratio of 1:1 of diameter to length have reduced bearing losses to a minimum.

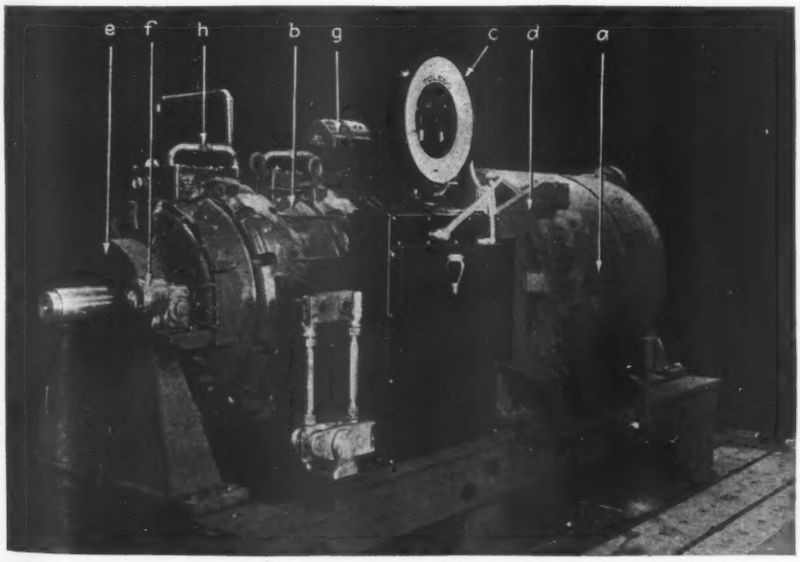
The sensitivity of the machine can be judged by observing the static balance of the unit. If the static balance is perfect, the amount of weight placed on the scale knife edge which is necessary to move the stator is a measure of sensitivity. This amount of weight is governed only by the stiffness of the electrical connections for field and armature leads, by the stiffness of the water hose connections to the eddy current machine and by static friction. The electrical connections were made of long loops of flexible strand copper supported from the bottom of the stator. Symmetrical arrangement and proper shaping of these connectors produces a certain amount of balancing of their stiffness with regard to the scale reading within the small movement of the stator. The sensitivity of the dynamometer can be reduced to less than .5 percent of the scale capacity.

The severe service to which these machines are subjected, makes rotation of the trunnion bearings an important factor. Rotation of the intermediate race reduces the static friction in the bearings by keeping all sliding surfaces continuously lubricated. The driving motors are arranged so that the trunnion bearings rotate in opposite directions in pairs in order to avoid the effect which any remaining friction may have on the scale reading.

The scale reading is also affected by some of the losses in the machines. Bearing and brush friction, d.c. armature I^2R, eddy current and core losses do not affect the accuracy of the scale reading with the dynamometer operating either as a motor or generator. However, part of the armature windage and the major portion of any ventilating fan losses may introduce an error in the scale reading if care is not taken to produce a windage reaction on the stator itself, instead of on the outside atmosphere. In this case guide vanes were assembled in the stator around the ventilating fan which transformed the radial flow of air into an axial flow of low velocity at the discharge. The windage losses due to the armature itself found their reaction wholly within the stator.

Windage losses due to the coupling between the two units will not introduce an error in the scale reading if the coupling is totally enclosed and if the enclosure is supported from the stator of the dynamometer. Drives taken off the dynamometer shaft for auxiliary apparatus such as exciter and oil pumps, etc., will not introduce an error in the scale reading if the driven apparatus is mounted on the stator.

Sleeve bearings used on the d.c. unit require less supervision during operation than anti-friction bearings and offer longer life when properly designed. Oil films which do not carry any load and produce losses only have been eliminated by large relief areas inside the bearing. The upper half of the bearing was relieved to $\frac{1}{8}$ in. clearance between the end seals. The lower half was relieved to provide a 90 deg. load carrying area. A large bearing clearance was used to facilitate establishment of an oil film. Rapid conduction of heat away from the journal and bearing was accomplished. The bearing shell was made from copper alloy having a high heat conductivity. The babbitt could then be soldered to the shell, thus reducing the resistance to heat flow from babbitt to bearing shell. Very thin sections of babbitt were used which further reduce the resistance to heat flow. The housing was made from aluminum alloy of good heat conducting qualities and it was ribbed to increase its cooling surface. Use was made of



General arrangement of a large d.c. dynamometer which is capable of testing high speed internal combustion engines of different speeds and ratings. The d.c. machine (a) is coupled to an eddy current brake (b) on a common bedplate, making a combination unit of 4000 hp., 700/2000 rpm. absorption capacity. The scale (c) is connected to the eddy current brake by means of reversing linkage. The heavy arms (d) transfer the torque reaction from the d.c. stator of the eddy current machine. Each machine is carried in a pair of trunnion bearings (e) with motor operated rotators (f). Each machine carries on its stator an exciter (g) which is belt driven from the dynamometer shaft. Water cooling inlet (h) for eddy current machine is made of a loop of flexible hose. The outlets discharge into stationary funnels.

Midnight at BEECHCRAFT . . . and the flow of production moves onward without limit and without end, night and day . . . a mighty and ever-increasing river, adding its volume to the boundless sea of airplanes and war materials whose angry waves will soon engulf our enemies.

BEECH AIRCRAFT CORPORATION
BEECH AIRPORT WICHITA, KANSAS, U. S. A.

Rivers Flow to the Sea

these ribs as structural members in giving support to the housing. A vigorous ventilation of the housing was provided. On the end of the machine where the ventilating air enters, a part of the air current was directed against the exposed surfaces and ribs of the housing. On the opposite end where the hot air discharges, the housing was shielded against the hot discharge air and a separate small fan was used to draw fresh air across the housing surfaces and ribs.

Rapid circulation of oil has been secured by using two heavy grooved oil rings. Special care was taken in the manufacture of the oil rings to make definitely sure that they were absolutely round and that even after they have been dismantled they could be assembled again into their original shape with great accuracy. The oil ring chamber in the bearing is designed so as to minimize the amount of friction between the oil ring and the bearing shell. Bearings designed with these points well taken care of can operate with journal speeds up to 400 ft. per min. On these particular machines a temperature rise of the bearing of only 30 deg. C. was obtained.

Aircraft Servicing Jack Is Arc Welded

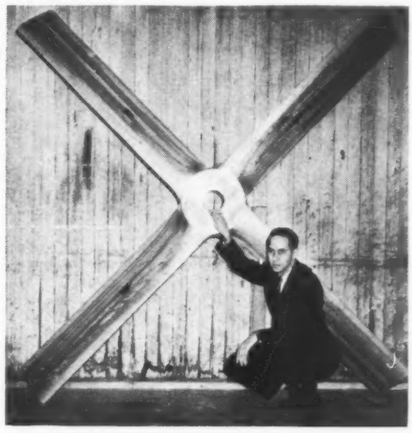
Servicing the great fleet of fighters and bombers, as well as the transports of the nation's airlines, involves extensive use of special jacks to facilitate the checking of brakes, shock absorbers on landing gears, and for the adjustment and replacement of engine parts.

The Templeton, Kenly & Co., Chicago, Ill., uses arc welding equipment supplied by the Lincoln Electric Co., Cleveland, Ohio, to speed production, reduce weight, and increase the strength of these jacks. A special pad, shaped to the contour of the wings, fits on top of the jack. The jack lifts to a height of 71 in. from a closed position of 41 in. and weighs 678 lb. It is operated with a speed crank to the jacking position and by a ratchet socket with a level bar to raise the actual load. The elevating sleeve is made of seamless steel tubing.

Stone Test Club

A 2500 hp. wood test club, which is thought to be the largest of its kind produced to date, is manufactured by the Stone Propeller Co., Wichita, Kansas. Made up of birch lumber, specially kiln dried, it has a ten foot diameter, 45 degree pitch, 14 inch blade. The test club has 30 laminations of birchwood for the blades, and the completed club has a weight of 150 lb.

With the entire production capacity of the company's new and modern factory being turned over to all-out for war needs, the Stone Propeller Co. can look back upon on experience covering almost the entire life of the industry. First established in 1910 as the Excelsior Propeller Co., Washington, D. C., it later moved to St. Louis, Mo., in 1912, where its propellers earned a high reputation. In 1917 the company was reorganized under its present name and moved to Dayton, Ohio, then the center of the aircraft industry, where, in conjunction with the U. S. Aviation Experimental Station, McCook Field, it manufactured all the experimental propellers for the army. Propellers were manufactured for the Liberty, Hispano-Suiza, Rolls-Royce, Curtiss, Hall-Scott, Gnome-Rhone, and other engines of the first World War period.



The 2500 hp. Test Club Propeller made by the Stone Propeller Co. for one of the big automobile firms in Detroit now engaged in aviation work. Great size of the test club may be compared with W. M. Stone, son of designer, M. J. Stone

Induction Design Criteria

For aircraft engine induction systems incorporating the so-called "ice-free" types of carburetors, an effort is being made to establish general design criteria for providing inherent freedom from icing hazards arising from *vaporization* of the fuel. In this work a great many test runs have been made with the Holley 1375 carburetor on Wright Cyclone R-1820 G-202 and G-201 induction systems, according to a report from the NACA.

From observations made during the test runs come the following conclusions:

1. Ice formed on inside of the induction system will not maintain its bond to the metal walls unless the metal temperature remains 32 deg. F. or lower.

2. Temperatures of the induction system metal exposed to the charge mixture will follow the temperature of mixture only so long as there is no coating of ice to insulate the metal from the refrigerated incoming charge. Heat from the ambient air surrounding the system and from other sources tends to raise metal temperatures after ice has formed.

3. In every test so far made with ambient temperatures substantially above freezing, ice did not bond with the metal but was supported by shape of the passage or protuberances within passage.

From these conclusions, general design criteria may be evolved:

1. To benefit from effect of insulation of metal walls by ice formations, which effect tends to prevent adhesion of the ice, the passages of the induction system should be designed so that ice formations (large and small) will not be retained by geometrical shape of the passage or by protuberances such as studs, thermometer bulbs, or thermocouples. (Note: Certain installations operated under certain conditions may not provide ambient air temperatures sufficiently high to furnish the required heat to maintain metal temperatures above freezing under the insulating effect of ice formations. In such cases, supplementary heating may be required.)

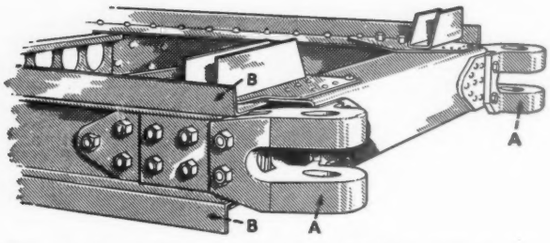
2. Since small ice formations tend to continually slough off the passage walls, passages should be designed and fabricated with aerodynamic cleanliness to facilitate the passage of the small pieces of ice as they are freed.

Houghton "Aerobutor"

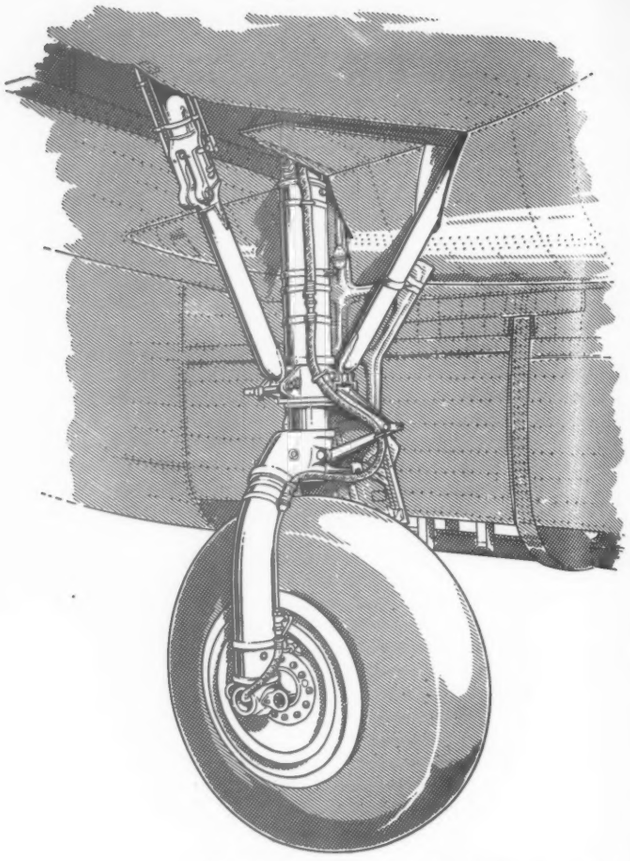
A Lockheed employee's hobby of machining rifle and pistol barrels is helping to speed production as a result of perfection of a new type aircooled welder tip.

Called the Aerobutor, the new tip was developed by Will S. Houghton, metal fittings leadman at Lockheed, where it is now being used throughout the welding department. The Aerobutor is finned with Dural between the tip and handle, thus carrying off heat generated and keeping both handle and mixing chamber cool. It is estimated the life of the tip is increased by 50 percent. Time saving and increased efficiency of the welding operator is also substantial through the improved cooling of the new type tip.

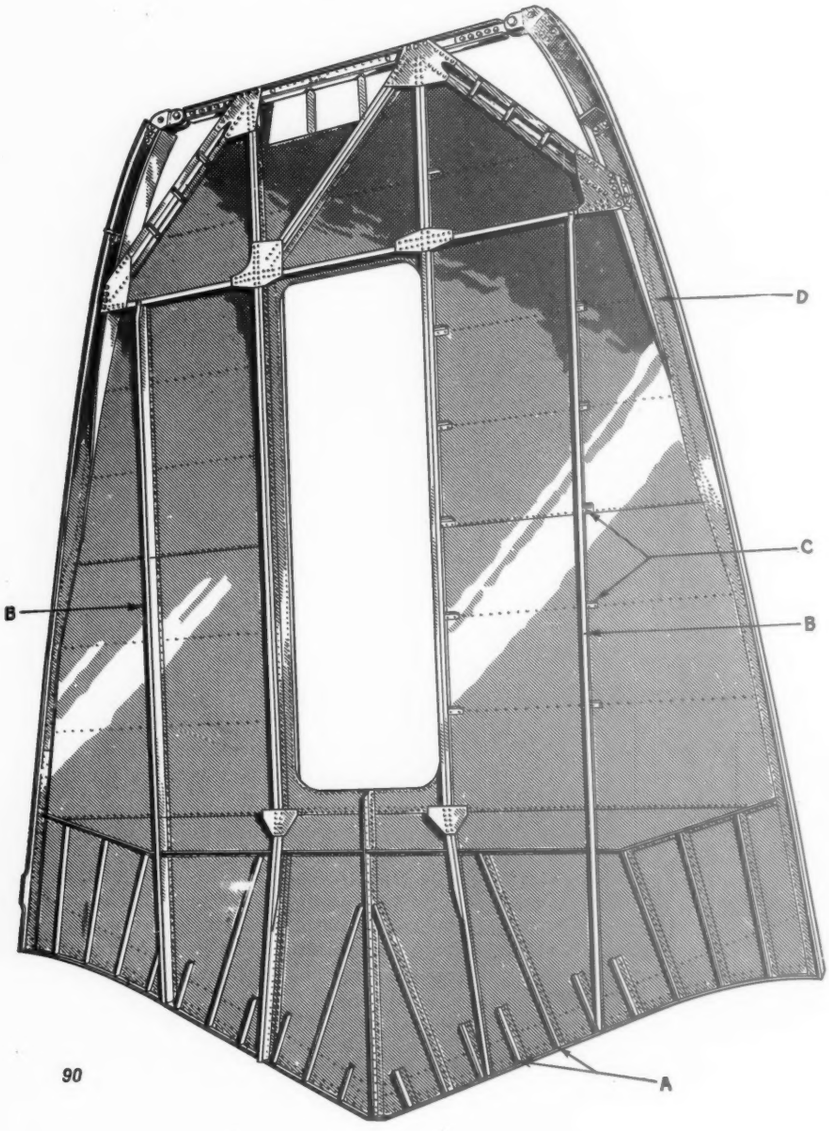
AVIATION SKETCH BOOK OF DESIGN DETAIL



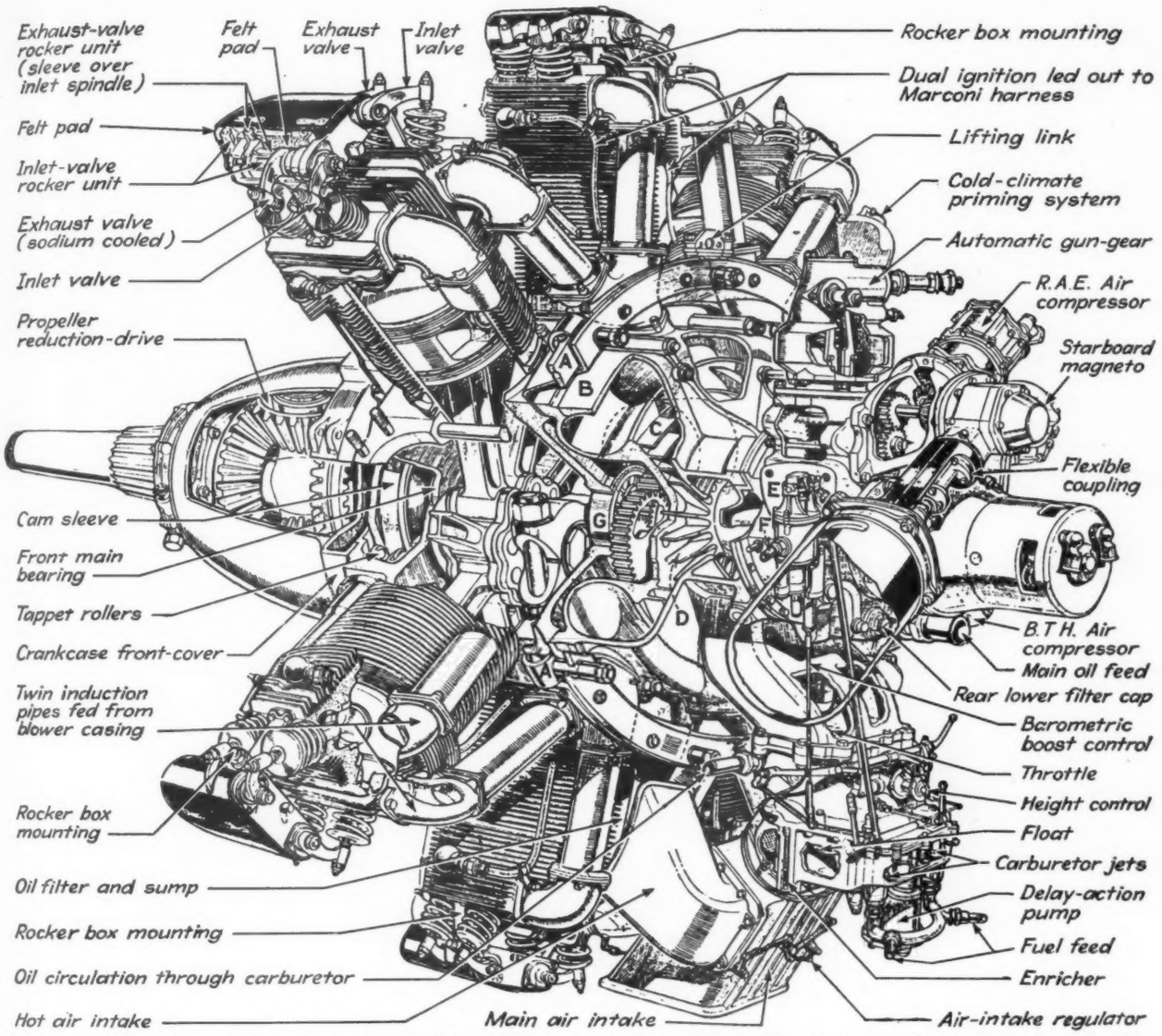
The rear beam hinge, above, of the VS-44-A wing is constructed of two steel forgings "A", one located at the top and one at the bottom of the beam. These are then bolted into place with ⅜ in. and 7/16 in. bolts. The fitting is placed between the two angle section longerons "B" running along the outside of the beam.



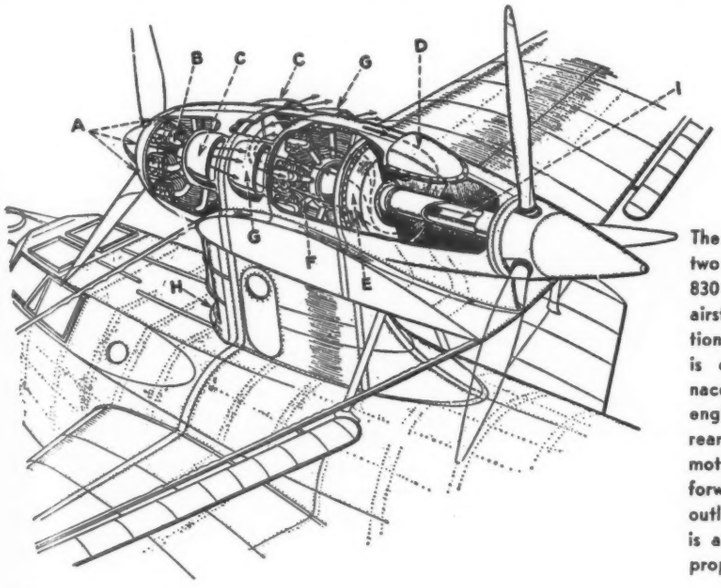
Above is shown the main landing gear and wheel of the Consolidated B-24 heavy bomber. In this airplane the wheels do not retract into the engine nacelles, but outwards into the wings.



The front main bulkhead of the Vought-Sikorsky VS-44-A, left, has been constructed with additional members along the bottom "A" to take the loads when landing. Compression loads are then transferred into the main section of the bulkhead. The two vertical members "B" are I-sections which are attached to the bulkhead by braces "C" as well as by rivets along the bottom. Notice how the member "D" changes from an I-section at the top, where the wing loads are brought in, to a T-section at the sides where this load is distributed to the rest of the bulkhead.



The cutaway view, above, is of the Bristol Pegasus XXII aircooled radial, a 9-cylinder type developing 1,010 hp. which is being used in many British and a number of foreign planes. It is built in Italy as the Alfa-Romeo RC. 126 (see Foreign Aircraft Engine Specifications, AVIATION, Feb., 1942), and is said to be the only engine flown over Mt. Everest (Courtesy *The Aeroplane*).



The Dornier DO 18K2 flying boat is powered by two BMW 132 radial engines rated at around 830 hp. each. The method of conducting the airstream for cooling purposes in the two installations, one a tractor and the other a pusher type, is of interest. The airstream "A" enters the nacelle, passes around the cylinders of the front engine, and exits at the two outlets "C". On the rear engine, however, the air inlet is behind the motor at "D" and a cooler fan "E" forces the air forward through the rear engine "F", with the outlets at "G". The air inlet for the oil cooler is at "H" and "I" is the shaft drive to the rear propeller. Redrawn from *The Aeroplane*.

Uses

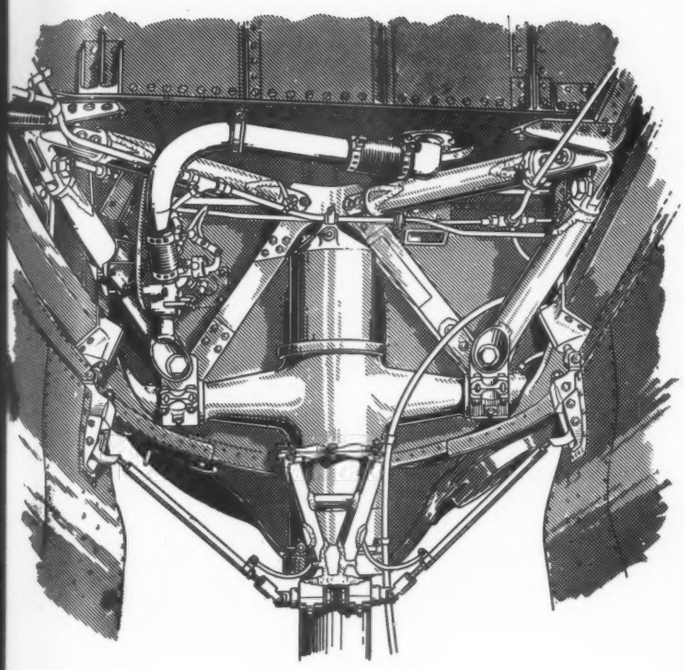
VICKERS HYDROMOTIVE CONTROLS

ENGINEERS AND BUILDERS
OF OIL HYDRAULIC EQUIPMENT
SINCE 1921

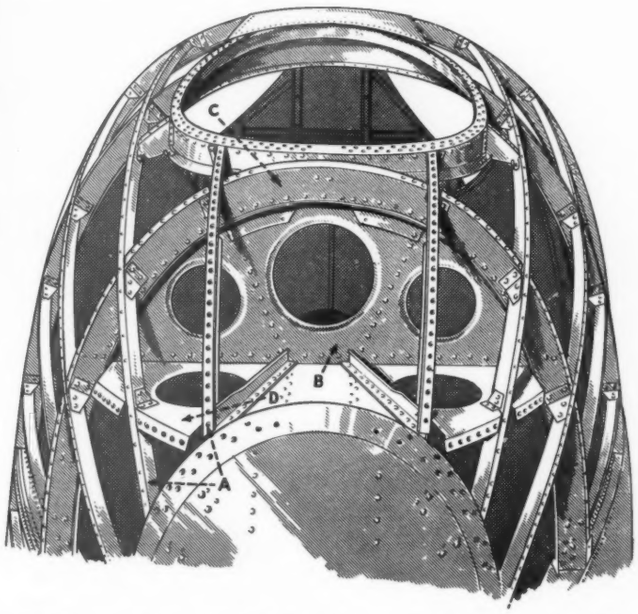
Vickers Hydromotive Equipment is used on many of the most modern airplanes. The Consolidated B-24 four engine bomber illustrated here is representative.

Vickers Hydromotive Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately . . . no matter how severe the service.

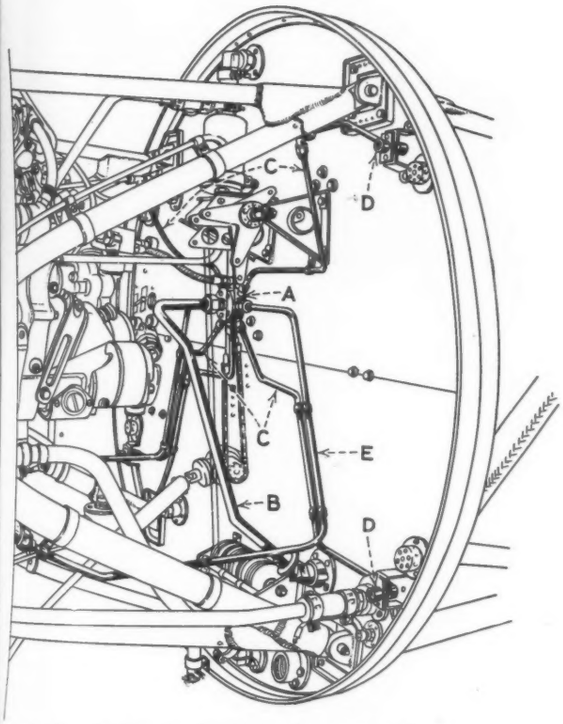
VICKERS *Incorporated,* 1462 OAKMAN BLVD. • DETROIT, MICH.



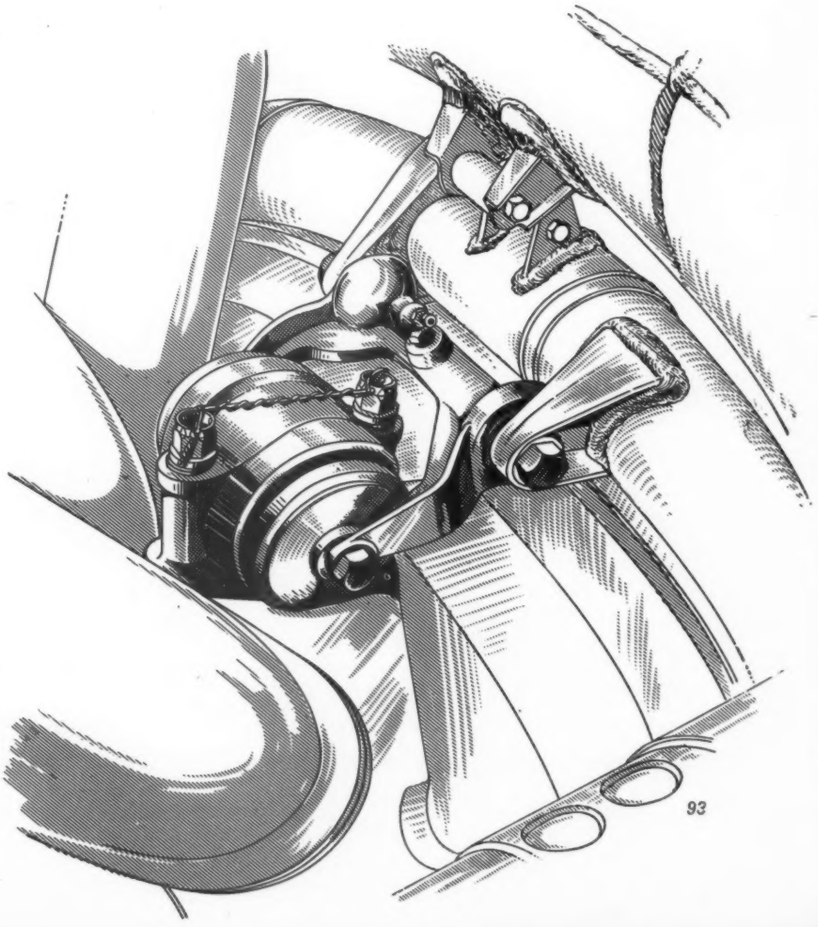
The Martin 167-W main landing gear attachment is shown in the rear view, left, looking forward under the engine nacelle. To the welded tubular torque scissor structure, push-pull rods are attached which are hinged to the nacelle doors, which are opened or closed with the lowering or raising of the wheel. The tube curving down the vertical strut is the hydraulic brake fluid tube.



The bow section of the VS-44-A, above, is made up almost entirely of angle sections "A" to which the skin is flush riveted. The front bulkhead "B" is of unique construction with an outer section "C" running around the periphery. A horizontal bulkhead "D" takes any load applied at the nose of the ship.



In the Vought-Sikorsky VS-44-A, the main fire extinguisher distributing unit, above, is attached to the firewall at "A". The extinguisher flows through the pipe "B" to the distributor which then passes it through pipes "C" leading to nozzles similar to those at "D". Also, the extinguisher is distributed forward to the engine through the pipe "E".



Close-up view, of Lord Dynafocal Suspension assembly used to isolate vibration of radial engines of 450 hp. and up. Employing rubber bonded to metal, this type of suspension is so designed that it provides center of gravity support which is said to efficiently isolate all forms of vibration caused by engines and propellers. The link connection by which the suspension assembly is installed on the engine mounting ring is attached by bolts through fittings welded to the ring.

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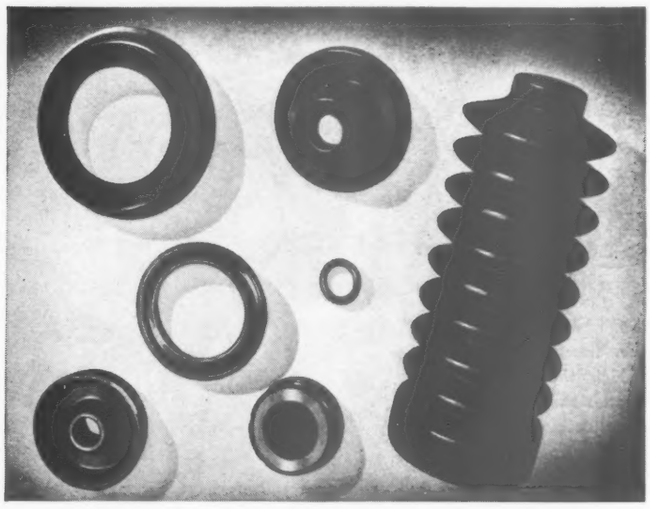
Any part of this weight that you save can be converted into that much more speed, range, altitude, fire-power or bomb load. That's weight-saving with a meaning.

Entirely aside from its superior resistance to aviation oil and gasoline, Hycar has made a major contribution to aircraft engineering with its light weight. Specific gravity of 1.00 enables this remarkable synthetic rubber to yield weight savings of 15 to 25% compared with many other resilient materials.

In the average airplane that can mean hundreds of pounds!

Today Hycar is being made into millions, *literally* millions, of individual parts in more than 3000 sizes and designs for aircraft. Wherever a resilient material is needed with resistance to oil and gasoline, to heat, abrasion, cold-flow and compression set—along with that all-important feature of light weight—Hycar is the material for the job.

Ask your suppliers of rubber products for samples made with Hycar. And remind them that our technicians are ready to help them meet your individual requirements.



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First class mail by air—overnight to all America... it will be an early and important step toward the tonnage air transport of tomorrow. More ships, bigger ships will follow, crossing present barriers of time and distance to establish the new freight and passenger routes of the world. Like the largest aircraft of the past and present, they will be powered by Wright.

WRIGHT

Aircraft Engines

North American B-25 fabricated with Boots Self-Locking Nuts

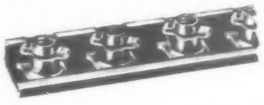
HOW BOOTS NUTS SPEED PRODUCTION FOR NORTH AMERICAN

With aviation swinging to modern assembly line methods, simplicity in design of parts is vital. The Boots "gang-channel" speeds production and reduces assembly errors for North American because it is tailor-made to North American's exact specifications.

The Boots "gang-channel" is designed to contain removable Self-Locking Nuts, which may be irregularly spaced to meet particular requirements. This nut assembly saves the time and cost of driving extra rivets.

The Boots "gang-channel" saves weight. And the removable channel nuts offer permanently safe protection against vibration because they contain the famous Boots all-metal self-locking principle.

Boots are the only one-piece, all-metal self-locking nuts to pass the rigid test of Army, Navy and the Civil Aeronautics Authority.

Self-Locking Nuts for  *application in all industries*

Boots Channel Nuts "Outlast the Plane"

BOOTS

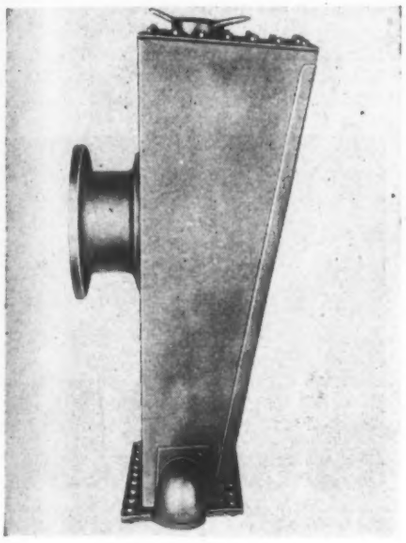
AIRCRAFT NUT CORPORATION

NEW CANAAN, CONNECTICUT

NEW EQUIPMENT

American-La France Evertite

Prepared for quick installation on modern oil storage tanks of the pressure type, "The Evertite" mixing chamber is described by its makers, **American-La France-Foamite Corp.**, Elmira, N. Y., as an effective method of applying a blanket of fire-smothering foam to burning oil surfaces. Vapor-proof glass diaphragm is so installed as to prevent vapors in oil



storage tanks entering mixing chambers; entering and condensing in chemical solution lines; escaping to the air when bottom or top plate, or inspection cap, is removed. Glazed in metal frame, diaphragm holds gas tank pressure, yet ruptures fully under foam pressure at time of fire, allowing free access of foam blanket to burning surface. Diaphragms are replaceable and separate adapter flange is provided for mounting over foam opening in oil tank shell. Expansion type chamber with increasing cross sectional area insures mixing of chemical solutions, formation of foam and low velocity delivery. For retarding corrosion a small hole in bottom plate allows air to circulate, and also provides drainage.—AVIATION, *March*, 1942.

Roxalin Safety Glass

A water-white, transparent liquid that prevents broken glass from flying is a discovery of **Roxalin Flexible Finishes, Inc.**, of Elizabeth, New Jersey. Roxaneal is not claimed to stop glass from fracturing, but tests reveal that it does keep broken glass in place, thus preventing dangerous glass splinters from flying. Explosion of dynamite only 30 in. away, and the impact of anti-aircraft shell end dropped from a height of four

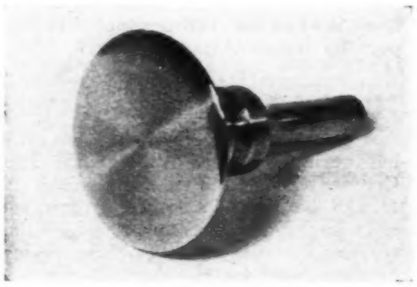
ft., left plain glass coated with the substance intact. For clear light, Roxaneal is available in transparent form, but is supplied in blackout type as well and may be applied by brushing on the interior of clean glass. Windows may then be cleaned whenever necessary with mild soap solution without affecting strength of protective film. Washing with solvents or peeling with razor blades easily removes the material.—AVIATION, *March*, 1942.

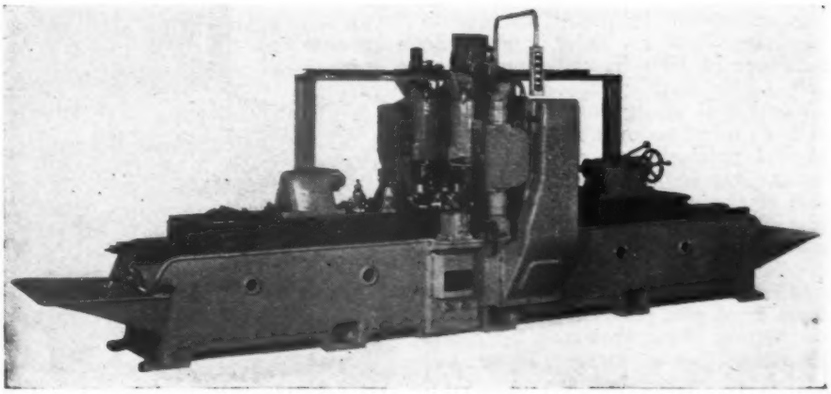
Sundstrand Miller

With propellerless planes still a rarity, milling the edges of propeller blades continues to be a necessary operation in all production plants. For this, **Sundstrand Machine Tool Co.**, 2563-11th St., Rockford, Ill., has lately completed a machine which mills both sides of the blade at once. It is done by means of two vertical type spindle heads mounted on a cross rail, driven from one gear box and having pick-off gears for simultaneous speed changes of both spindles. The part is held on machine table between headstock and foot stock member and supported by jacks. Button on electrical control pendant starts spindle, hydraulic and coolant motors. Machine has 90 inches of power feed in a feed range from ½ to 38 in. per minute (or rapid traverse at 300 in. per minute). The feed unit is of Fluid-Screw Rigidmil type in which the table is actuated by a screw, in turn controlled by a hydraulic transmission. This arrangement provides advantages of mechanical feed as well as flexibility and smooth control of hydraulic feed.—AVIATION, *March*, 1942.

Aircraft Rivet Sets

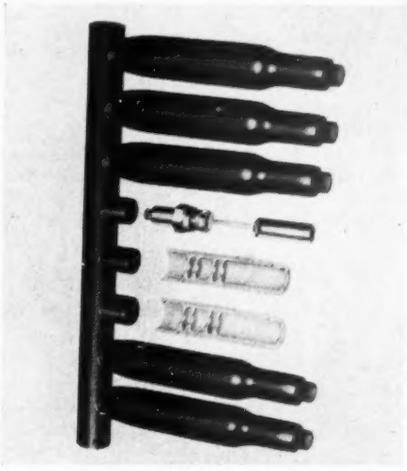
The ultimate in precision and strength, and designed particularly for aircraft riveting, a new type of rivet sets are being brought out by **Products Engineering Co.** of 700 East Florence Ave., Los Angeles, Calif. Available in two types, for Flush Riveting or for Standard Brazier and Round Head Riveting, these new Peco Rivet Sets are ground to rigid specifications of shanks and faces and are claimed to be almost foolproof even when used by amateurs. Flush Sets have face design that eliminates dishing and marring of skins and surfaces. Standard Sets are constructed to avoid ringing and marking when tipped to angles up to 7 degrees.—AVIATION, *March*, 1942.





Burndy Mole

A new type of insulated connector especially made for use in the junction, or limiter boxes of industrial secondary networks can be found at **Burndy Engineering Co., Inc.,** 459 E. 133rd St., New York, N. Y. The special Mole consists of



central conducting body, surrounded by a molded insulating jacket, and contains numerous cable outlets. Flexibility in number of outlets allows for addition of taps without disturbance. The new Mole is furnished in many types—two of more popular being Type ZMEJ and ZMEH. Type ZMEJ has extended ends, which enable connector to be supported on grooved insulating strips mounted in limiter box. Type ZMEH has tapped holes in each end of main conducting body, and is fastened to insulating support by bolts.—AVIATION, *March,* 1942.

Ny-Lint Tool Grinder

A new Gap Gage Grinding Machine has been introduced by **Ny-Lint Tool Company,** 1823 16th Ave., Rockford, Ill. It can be used for grinding gap and snap gages and various other grinding services. Simple operation requires few hours training for beginner. Double end spindle is of chrome nickel steel, mounted on high-precision, pre-loaded ball bearings in precision ground housing, and driven by pulley balanced to eliminate vibration. Table is ground to tolerance of .0001 in. and mounted on cross slide with precision alignment. Longitudinal adjustment of table is obtained with accurate, hardened and ground precision screw working in a bronze nut and fitted with micrometer dial reading to .0001 in. Cross slide is mounted on V-ways of a size to insure maintenance correct alignment, and are precision scraped and spotted. Quick and smooth movement is provided by a lever fitted with pinion engaging a rack on bottom slide. Protection by covers extending beyond travel limits and sealing of spindle bearings to exclude

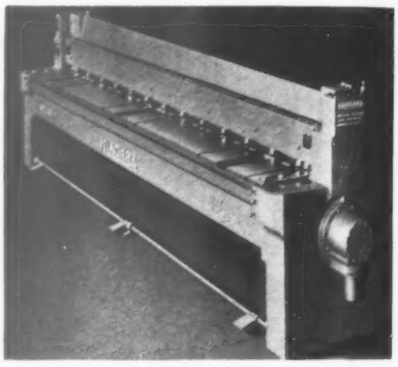
abrasive dust adds to the long list of superior features of the Gap Gage Grinding Machine.—AVIATION, *March,* 1942.

Burklyn Test Stands

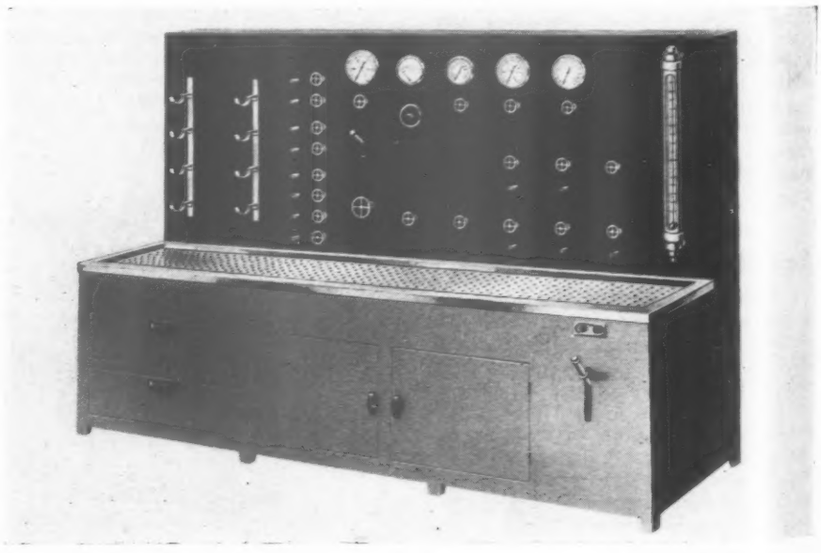
Four new types of test stands constructed by **Burklyn Corp.,** Los Angeles, Calif., are claimed to be successfully meeting specialized requirements of maintenance and service bases for hydraulic test stands, and the growing need for test stands to handle various types of pressure and vacuum pumps. Basic unit is complete stand for hydraulic cylinders, control valves, pumps, relief valves and component equipment. Pressures up to 16,000 p.s.i. are available on this unit. The other three are for fuel pump, hydraulic oil pump and vacuum pump testing. Hydraulic systems bench is perforated metal sheet covered, forming convenient sink over which to work. All gages and valves are on a vertical back panel, made from ¾ in. Masonite. Under sink is 10 hp. motor driven pump delivering up to 10 g.p.m. at pressures to 2,000 p.s.i., and a multiplier cylinder provides up to 16,000 p.s.i. pressure. Of special interest is variable speed drive between motor and pump, which gives a variable flow output to the pump. A 25 gal. reservoir for hydraulic fluid is provided and a relief valve set at 2,000 p.s.i. is attached to pressure accumulator. For protection against dirt special filters and oil strainers have been provided as well as a wire mesh intake screen for the reservoir. Heat exchanger on which are thermocouples to give exact temperatures of in-going and out-coming oil, varies amount of cooling water so any desired temperature of oil can be maintained.—AVIATION, *March,* 1942.

Niagara Machine Shears

Cutting of sheared edge and narrow strips that are straight and parallel to within a few thousandths of an inch, is made possible by the advance design of Series No. 3 power squaring shears. **Niagara Machine Tool Works,** 637-697 Northland Ave., Buffalo, N. Y., has built



these to operate at a speed of 80 strokes per minute. Because of the instantaneous Niagara sleeve clutch and ball bearing self measuring back gage, reduction of fatigue in handling is assured, company says. Enclosed and operating in oil, drive mechanism includes fly wheel, gearing, clutch, eccentrics and connections. Motor is direct connected. Series No. 3 shears come in four to 12 foot cutting lengths.—AVIATION, *March,* 1942.



Edroy Eye-Shade

Of national importance today are inventions contributing to the welfare of industrial workers. One of the newest developments along this line is the Magni-Focuser Eye-Shade obtainable at **Edroy Products Co.**, 480 Lexington Ave., New York, N. Y. This eye shade is

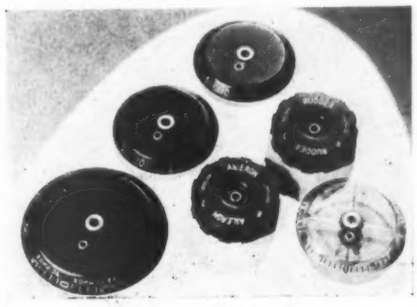
equipped with a pair of stereoscopic five power magnifying lenses, which a slight tilt of the head brings into use. For normal vision wearer merely looks down beneath the shade. The head lenses are superior to old fashioned magnifying glasses in that they are third dimensional and do not require manipulation by hand. Magni-Focuser is strongly made of plastic and shaped to protect the worker's eyes from flying pieces of steel or shavings.—AVIATION, *March*, 1942.

Walker Gripmaster

Aircraft today undergoing severe treatment should find Gripmaster Strain Reliefs preservation factors of value. **George Walker & Co.**, 118 Amsterdam Ave., Passaic, N. J., makes these gadgets in three models for application to cord and cable. All-Metal type is of one piece and comes in five different sizes. Fastened to end of cable or conductor with pliers, wing-end construction of Gripmaster All-Metal type permits cable to be firmly anchored in product housing, and to resist great pulling and twisting, it is said. No asbestos tape insulation is required on conductor. Click-On two-piece, hinged construction type of strain relief clamps about cable where it "clicks on" by means of locking device. Its tight grip effectively absorbs cord pull, prevents braid unraveling, eliminates need for thread binding or tape insulation, manufacturer claims. To all cord equipped electrical units, Insulated type gives positive protection, anchors cord to product housing at point of maximum strain and supplies, even, firm pressure. These last two strain reliefs come in seven sizes.—AVIATION, *March*, 1942.

Erie Resistor Dials

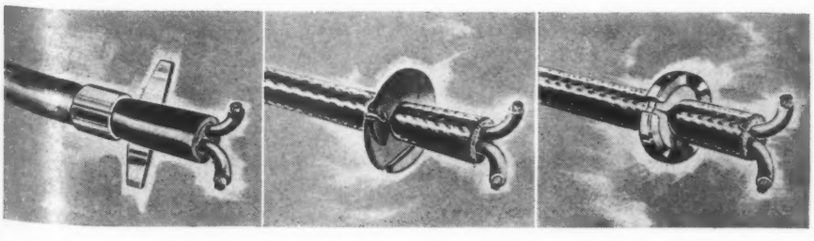
Substitution of molded plastics aircraft knobs and dials for old type metal instruments insures greater visibility of dial markings for pilot and provides him with lighter, longer-wearing parts. Plastics Division of **Erie Resistor Corp.**, 644 W. 12th St., Erie, Penna., molds these knobs and dials of clear plastic, indenting letters and characters on rear surface. Characters are then coated with fluorescent material that glows when exposed to ultra-violet light. Over this is applied a special paint which does not reflect light, thus making marks easier to see in daytime. Neither luminous material nor background paint is subjected to surface wear, being on back side of parts. Removable characters can be easily seen from oblique angles, readable over an

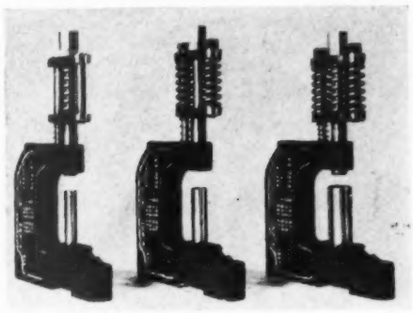


arc exceeding 180 degrees. Details of gadgets were developed jointly by engineering departments of Curtiss-Wright Corp. and Plastics Division of Erie Resistor.—AVIATION, *March*, 1942.

Selective Strippers

Latest in the complete line of Wales Hole Punching Dies, selective strippers, have been announced by **The Strippit Corp.**, 200 Niagara St., Buffalo, N. Y. These new strippers with three removable and interchangeable springs provide a tension selection of 1, 2 or 3 spring pressure for exact stripping action required by various gages and types of metal. Simplicity of design makes changes of pressure instantaneous. Lighter gage metals not requiring full stripping pressure can be punched on

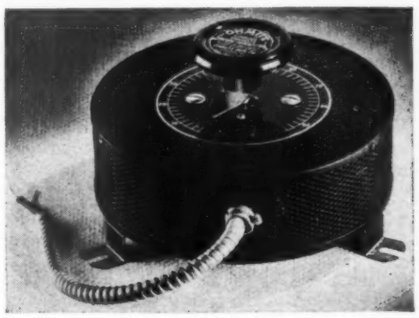




smaller, more economical presses by eliminating unnecessary high spring pressure. Wales Dies save time because they are self-contained units. Nothing is attached to ram of press. Each unit may be reset or removed from rail quickly. Free floating punches may be lifted out of their guides, and even punches, guides and springs may be removed from holders immediately. New Selective Stripper gives perfect stripping control besides making it possible to punch $\frac{1}{8}$ in. holes on $\frac{1}{4}$ in. centers. These Dies are available in wide range of standard and special sizes, capacities and models.—AVIATION, *March*, 1942.

Ohmite Rheostats

A variety of Rheostat Cages has been developed by **Ohmite Mfg. Co.**, 4835 Flournoy St., Dept. 7H, Chicago, Ill., for use with Ohmite Rheostats. A cage enclosure is a convenient form of table top or surface mounting and is advisable where there is possibility of mechanical injury to rheostat or human contact with electrically live parts. Surface mounting cages are widely used in connection with fractional hp. motor controls; heating



device controls; on dental and medical equipment; and in laboratories. Types with perforated sides are most generally applicable. Others are dustproof cages, cages to house rheostats in tandem, explosion proof cages, ventilated cages with one-half closed as splash guard, and laboratory type semi-enclosed table-top cage. Various types of terminals can be supplied.—AVIATION, *March*, 1942.

Acromark Symbols

One hundred simple new symbols have been designed for Inspectors Sym-

THE WORLD'S *Deadliest* DIVE BOMBER

Curtiss Wright

FIRST

Since the Birth of Aviation

1928·First United States Navy Airplane built specifically for dive bombing tactics and carrier operation. Two fixed guns in upper panel and a rear swiveling gun completed the armament.

1933·Further streamlined, using a twin-row radial engine for higher performance, the now famous Curtiss Helldiver was in use by both the United States Navy and Marines.

1937·High performance dive bomber with heavy defensive armament and completely retractable landing gear. Many squadrons of the Curtiss SBC-3 type operated from carriers of the United States Fleet.

1939·The SBC-4, powered with a Wright Cyclone, superseded the earlier type and excelled its performance. Planes of this model were still being delivered to carrier-based Navy units and Reserve ground bases in 1940.

Send for YOUR copy of this fascinating 64-page history of aviation by Assen Jordanoff, author of "Your Wings", with illustrations of current fighting types. Send 10¢ to cover mailing cost: Airplane Division, Curtiss-Wright Corp., Buffalo, New York.

...MODERN DESCENDANT OF THE WORLD'S *first*

● In 1928 Curtiss-Wright produced one of the first airplanes designed specifically for dive bombing, a maneuver conceived and pioneered by the United States Navy. Today's Curtiss Dive Bomber, the SB2C-1, gives America a weapon which, in its classification, has yet to meet its equal in speed, range and striking power. This latest descendent of the long line of Curtiss "Helldivers" outspeeds its immedi predecessor by 100 M. P. H. — flies tw as far—carries double the armament w twice the number of heavy bombs. The SB2C-1 is but one of *seven* types modern military aircraft whose lar scale production in Curtiss-Wright's fo great airplane plants is a contribution first importance to National Defense.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION
BUFFALO, N. Y. COLUMBUS, O. ST. LOUIS, MO.

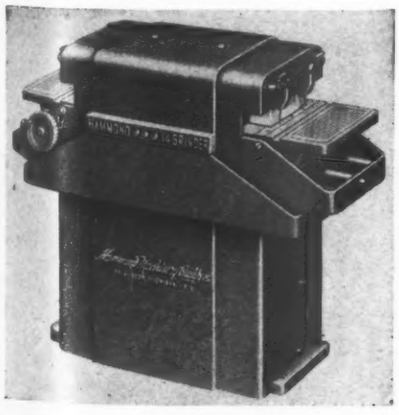
bol Stamps by **Acromark Corp.**, 239–267 N. Broad St., Elizabeth, N. J. Simplicity of each symbol gives maximum strength to stamp and permits number to be added if desired. Sharp and distinct marking prevents errors caused by similarity of marks. Each stamp is individually engraved in Acromark "Heavy Duty" manner for hard service and steel tapered to symbol so you can see where you are stamping. If several inspectors use same symbol, it is usually made to include a number, but separate one for each user is preferable. Front of stamp has symbol identification number and size so marks will not be stamped wrong side up, also to assist in classifying.—AVIATION, *March*, 1942.

S. & W. Black Out Paints

Successful concealing of strategic military and civilian objectives can now be done with camouflage paints manufactured by **Sherwin-Williams**, Cleveland, Ohio. The paints dry without gloss and the colors approximate appearance of different kinds of terrain as seen from the air. They may be had in such shades as field drab, earth brown and dark green, meeting standards established after years of testing by Army experts, and requirements of Office of Civilian Defense. Spread indiscriminately over roofs, buildings, streets and structures of all kinds, these colors will "re-make the map." One of the most immediate uses, it is believed, will be in repainting of gasoline and oil storage tanks and tanks to confuse enemy bombers.—AVIATION, *March*, 1942.

Hammond Tool Grinder

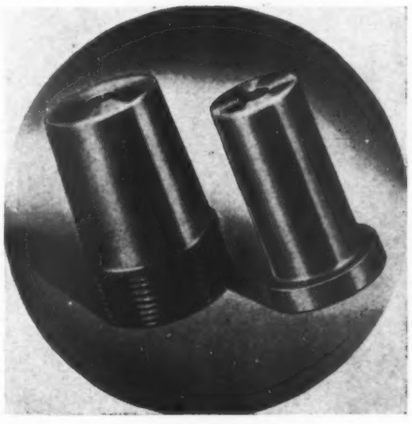
New Carbide Tool Grinder is announced by **Hammond Machinery Builders, Inc.**, 1638 Douglas, Ave., Kalamazoo, Mich. The Hammond "14" is available for either wet or dry grinding and is built in two models—cup wheels both sides or cup wheel one side and straight wheel the other. Tables are mechanically controlled, angular setting of each obtained by a hand wheel graduated to degrees. One revolution of hand wheel



equals 30 deg., angular range being from 15 to 30 deg. below horizontal. A crank handle moves the table in or out from the wheel and uniform distance between operator and wheel face is maintained by coordinated movement of wheel hood and sludge pan with table. Table surface is grooved, facilitating tool movement, and has generous dimensions of 22 x 12 in. Compound protractor tool gage has been developed for use on table which not only slides in the table slot parallel with the wheel in a regular manner, but also has a cross slide for sliding toward the wheel. Cross slide permits use of the protractor when grinding parallel or at slight angle with the tool. This protractor allows angles from 0 to 90 deg. For wet grinding the Hammond "14" has a coolant system, the coolant pump being powered by ¼ hp. motor providing coolant to both wheels. The Grinder is powered by a 3 hp. reversing motor and is multi-V-belt driven. Spindle speed is 1350 r.p.m., providing wheel speed of 5000 SFM.—AVIATION, *March*, 1942.

American Foundry Nozzle

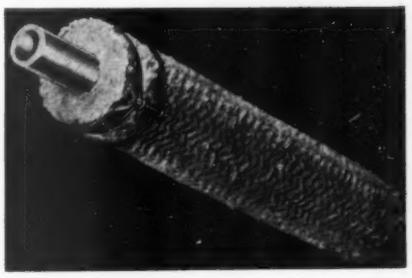
News of a major development in abrasive blast nozzles comes from **American Foundry Equipment Co.**, 555 S. Byrkit



St., Mishawaka, Ind. The New American-Heanium Long-Lyfe Blast Nozzle has insert of heanium, hard abrasion-resisting ceramic now used instead of metal. This nozzle wears slowly and evenly, thus keeping cost of compressed air at minimum. Since original orifice shows no appreciable wear even after hundreds of hours of service, contour of blast stream is maintained and the work is cleaned faster and more uniformly. Jacket enclosing insert is of abrasion-resisting alloy steel. According to tests, further features of tool are high finish bore, mechanical strength, and adaptibility to any equipment. Two types available are flange type and screw.—AVIATION, *March*, 1942.

Union Asbestos Insutube

Development of Insutube by **Union Asbestos & Rubber Co.**, 1832 S. 54th



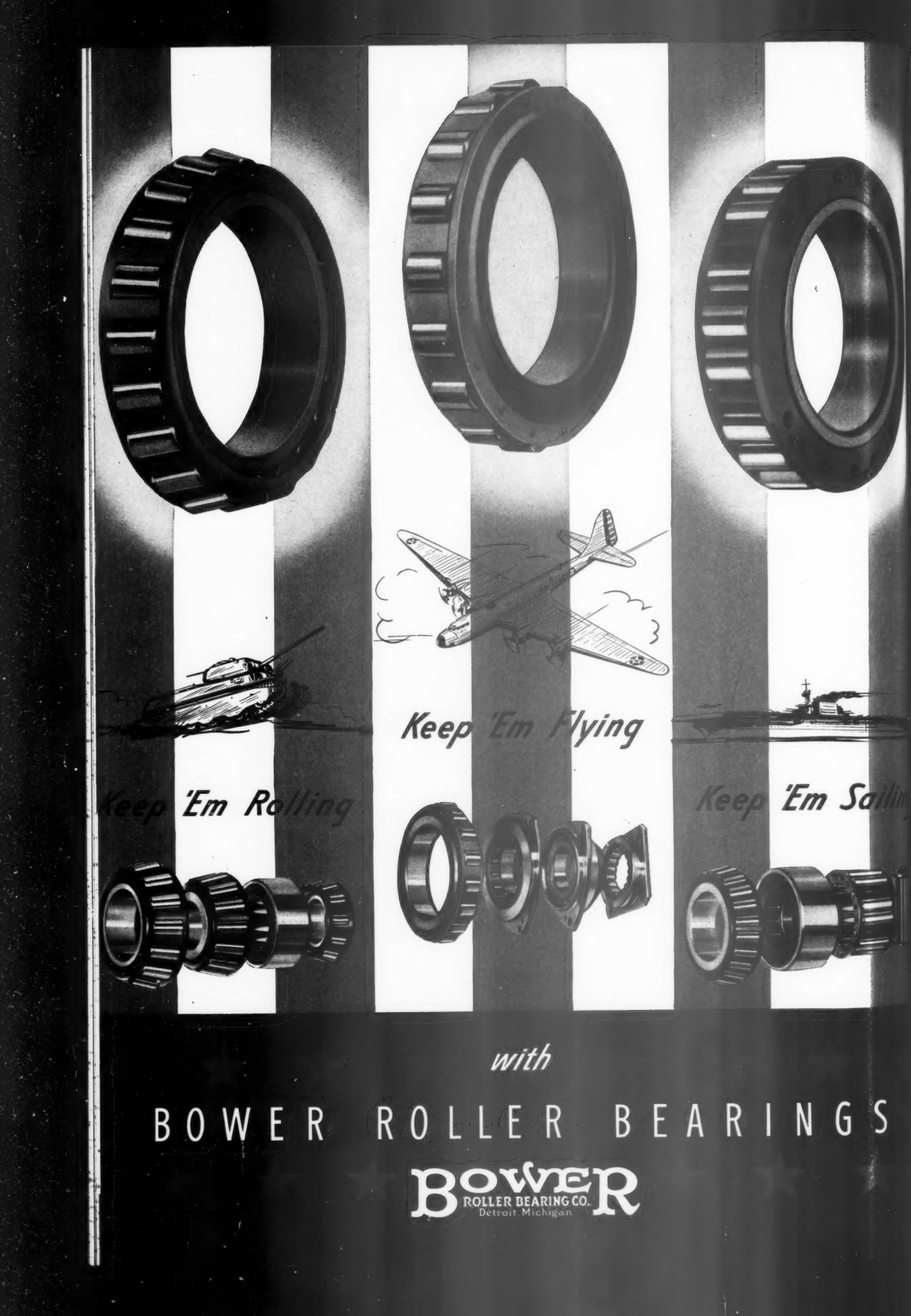
Ave., Cicero, Ill. is the result of problems encountered in insulating small diameter heating lines on large airplanes. Light weight, small size and ability to stay put under sever shock and vibration, make it acceptable in installations where small pipe or tubing is used to carry hot gases or liquids. The material is made in form of a seamless braided tube of long fibre asbestos with wall thickness of ½ in. in sizes to fit pipes one in. I.D. and smaller. Comes either plain or with water and grease repellent coating. In applying, the insulation is slipped on before assembly and clamped at either end after being stretched tightly lengthwise on pipe. Ordinarily it is packed in reels of 100 ft., but can be furnished in any desired length. Weight averages about .30 lb. per running foot in the ½ in. I.D. size. For temperatures above 500 deg. F., special material can be supplied, while for lower temperatures, standard grade is recommended. —AVIATION, *March*, 1942.

Commercial Chemical Cleaner

Miraculous new artificial glass cleaner for all kinds of glasses used in airplanes is said to come from **Commercial Chemical Company, Inc.**, of Charlestown, Massachusetts. Plasticlear will not scratch or dissolve plexiglas, lucite, acetate or nitrate glasses, yet renders clear vision, according to company. This new product also provides protection to the glass itself, and reduces the freezing of ice on the glass at high and cold altitudes. The pint jars in which it comes will take care of from 18 to 22 glass windshields and other glass windows in planes, depending on size and area of glass.—AVIATION, *March*, 1942.

Clayton Bar Holder

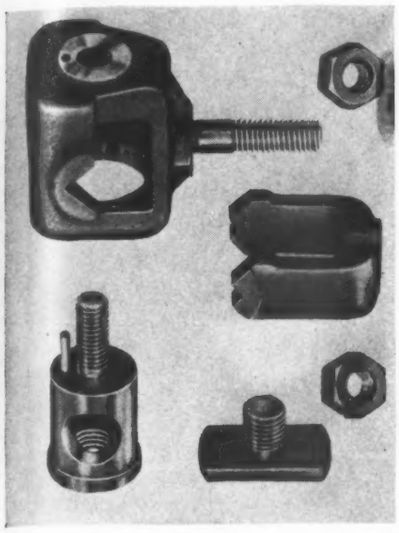
Necessity of complete realignment during various operational changes is eliminated by the two-way locking device on the new Clayton Boring Bar holder. **Clayton Manufacturing Co.**, Alhambra, Calif. explains that the boring bar lock being independent of clamp which locks bar holder to lathe, allows bars to be changed, tool bits raised or lowered, and distances shifted, without disturbing alignment of holder with lathe. For later duplicate operations, holder can be removed yet boring bar



with

BOWER ROLLER BEARINGS

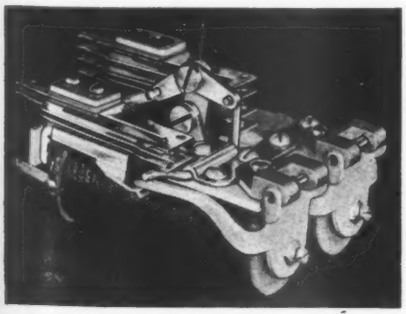
BOWER
ROLLER BEARING CO.
Detroit Michigan



setting will remain intact. A sliding dowel maintains constant alignment of center posts and V slots in body, so that any bar within range is instantly centered and locked. Permanently graduated in ¼ in. calibrations to indicate depth of bore, these bars do not require the usual marking with chalk and file. Five sizes of holders, for 9 in. to 28 in. lathes, are available, in complete sets with boring bars, or as individual tools. Boring bars are supplied in diameters from ⅜ in. to 2½ in.—AVIATION, *March,* 1942.

Automatic Electric Relay

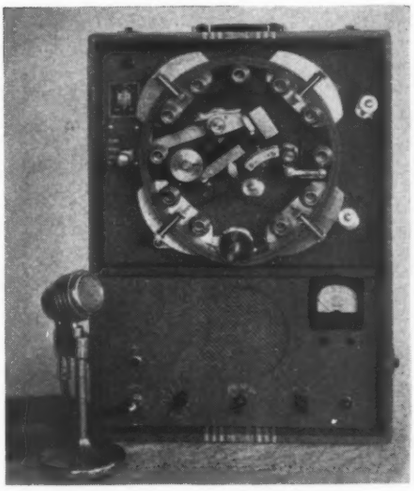
Two types of relays which have successfully passed all tests for service in Army aircraft are being produced by **Automatic Electric Co.,** 1033 W. Van Buren St., Chicago, Ill. Basis of these



relays is high-grade "telephone-type" relay, having pin-mounted armature which is said to be exceptionally durable. For aircraft service, this mechanism has been modified by the addition of damper springs on the armature and its bearing pin, to insure consistent operation under conditions of extreme vibration and shock. Other features are very rigid assembly and secure mounting; impregnated coils, unaffected even by 95 percent humidity, and choice of adjustable or fixed residuals in various sizes. Type 17 relay has one or two snap-action switches (make, break or transfer contacts, to make 1150 watts, break 690 watts, at 115 volts AC), or with one snap-action switch and one spring assembly (up to ten springs). The Type 18 relay has spring assembly only. Contact springs are offered with wide choice of contacts.—AVIATION, *March,* 1942.

Continuous Tape Recorder

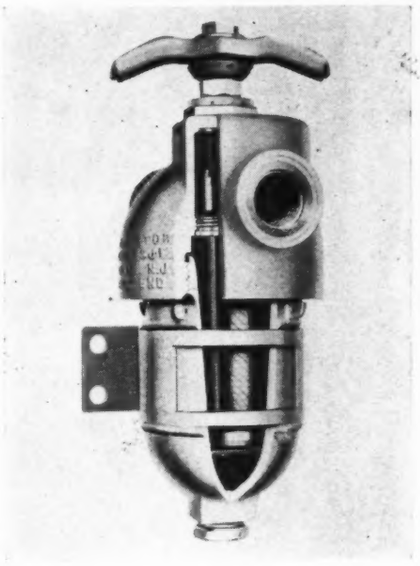
Making use of non-inflammable acetate film as a means of permanent high fidelity reference recording and automatic play-back, **Jefferson-Travis Radio Mfg. Corp.,** 380 2nd Ave., New York, N. Y. is building the Fonda AV Tape Recorder, for airline dispatch offices, airport control towers and wherever a continuous recorder operating for periods up to four hours without supervision is desired.



This instrument consists of an amplifier, microphone, recording and play-back mechanism and is contained in a sturdily made light weight carrying case. Operates by plugging in power line to convenient electric outlet and connecting recorder to radio, telephone line or a microphone. Continuous and exacting service without frequent maintenance attention is insured by constructing mechanism to the close tolerances of precision standards. Save for changing of tape at the end of four hours no supervision is needed through a normal eight hour day's operation. Titles of reference material can be marked on the tape and its filing carton. Company states that needle changing is eliminated and reproduction is exceptionally distinct.—AVIATION, *March,* 1942.

Purolator Filters

Planes demanding the protection of good filters for hydraulically controlled systems, may now be supplied by **Purolator Products, Inc.,** Newark, N. J., with Purolator Filters which filter hydraulic oil for the usual units and often retract-



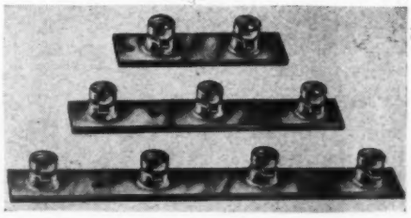
able landing gear and gun turrets as well. The G-159-J3 Aviation Oil Filter weighs only 1½ lb. Operating pressures for it are 1,000 to 1,500 p.s.i.; bursting pressure, 4,170 p.s.i. and above.—AVIATION, *March,* 1942.

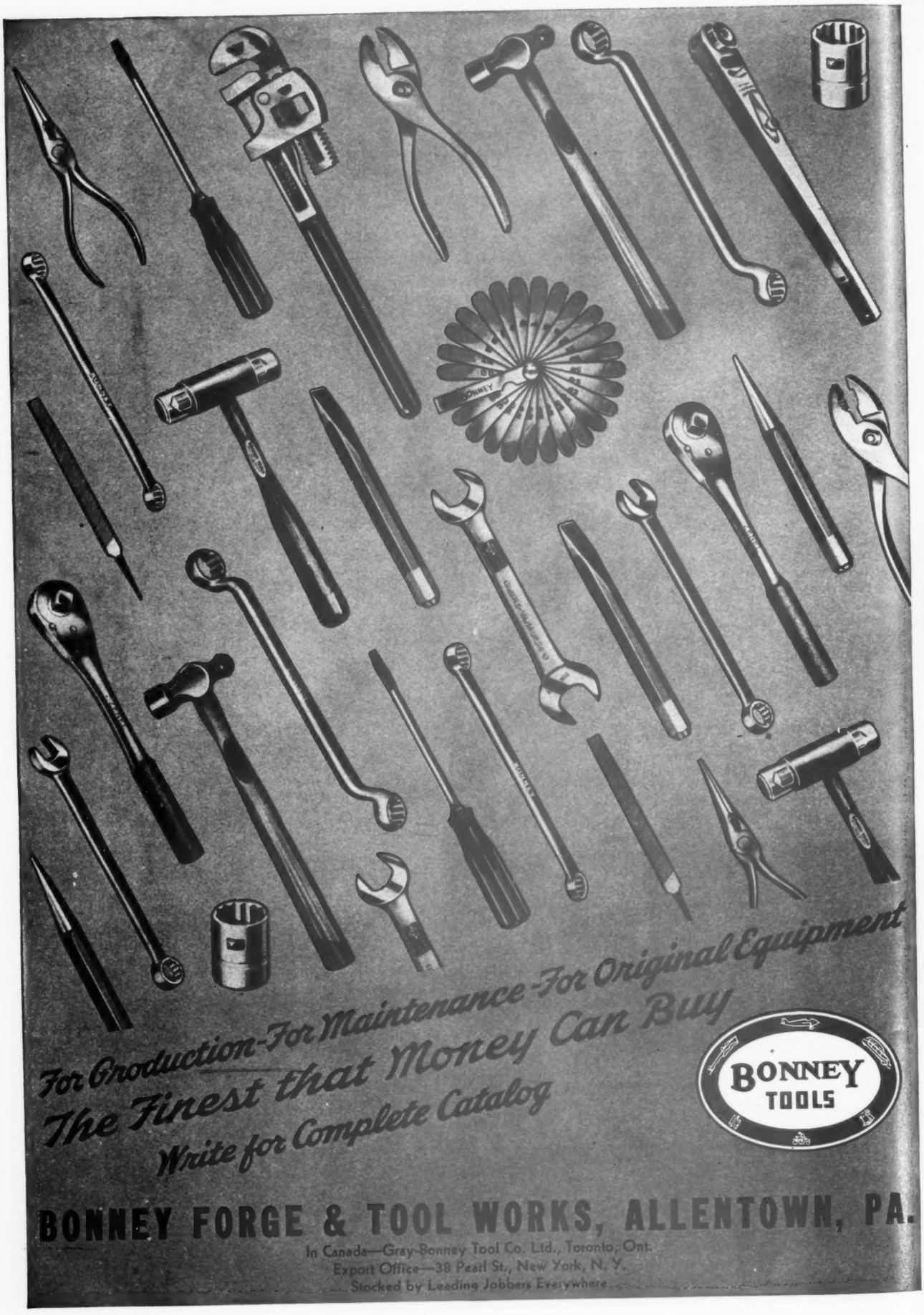
Denison Press

Solving your emergency production problems may be done by tooling the DLSC2 Denison HydrOILic Straightening Press for operations other than the intended one. **Denison Engineering Co.,** Columbus, Ohio, suggests using their Press for assembling, which can be done in small work such as pressing gears and bearings on and off shafts. For this purpose attach a ram of the size of thread of the ram, and bored out to clearance diameter of shaft. The tooling will then assemble equipment on shaft, within capacity of the press. In broaching operations DLSC2 can be used for shallow broachings and for thin sections of steel or castings. Press must be inched down to avoid distortion of steel or cracking of casting. Assembling springs on transmission; various types of bending; and core forming, may also be accomplished by the Denison HydrOILic.—AVIATION, *March,* 1942.

Boots Rivet Saver

A real saver of time, cost and weight, according to maker, is the Boots "Rivet-Saver". Elimination of two to six rivets on each application, **Boots Aircraft Nut**

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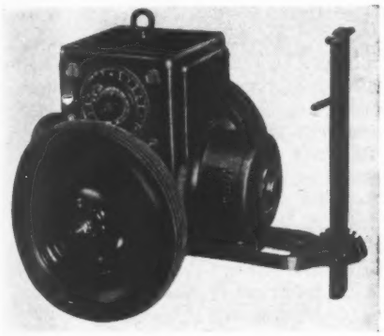
Stocked by Leading Jobbers Everywhere

Corp. says, cuts time and expense. Confined areas where normal riveting is impossible present no problems to this self-locking multiple unit anchor nut, it appears. Base of sheet metal nut fits special narrow, thin gage steel channel to which nuts are gang welded. Effectiveness of weld and lock-nut is seen in vibration tests. Composition entirely of sheet metal provides high resistance to temperature and heat, and lessens weight 18 percent to 66 percent, depending on style and size of nut, this company claims.—AVIATION, *March*, 1942.

Hobart Welders

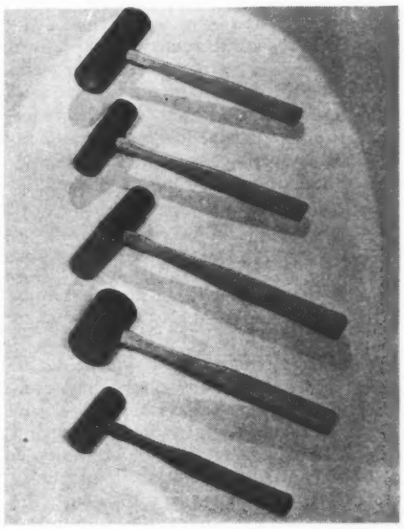
Destined to play a big part in emergency production, this all arc welded steel trailer is capable of trailing over rough terrain at 35 m.p.h. **Hobart Bros. Co.**, Troy, Ohio, have constructed the lightweight, pneumatic-tired device for



mounting 200, 300, 400 ampere Hobart electric drive welders. Mounting is accomplished by means of three bolts in frame of trailer which register with three holes in legs of welding machine. Combination tow bar and standing support has hand-operated ratchet for locking support arm in position. Unit is easily moved by hand by virtue of low, underslung construction, narrow tread, and precision method of balancing. Measurements are 54x45x27 in. (over tires); 13 in. axle center.—AVIATION, *March*, 1942.

Densewood Mallets

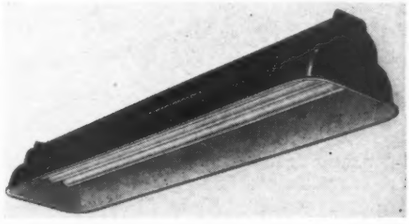
Densewood Corp., Elkhorn, Wis. can now supply you with mallets of converted wood substance having high compressive and tensile strength as well as great durability. Mallets of Densewood are said to be strong enough to take wrinkles out of heavy sheet metal without scratching or stretching the metal. With these tools ¾ in. pipe can be flattened until pipe breaks at edges, yet Densewood head will not split. High co-efficiency of friction on side grain, low on end grain, greater resiliancy, resistance to abrasion and heat, ability to withstand shock and vibration are further claims. Actual use, manufacturer says, shows they develop no static electricity, can be easily machined and polished, and last four to twelve times



longer than other mallets. "Lock Wedge" method locks handle in position for life.—AVIATION, *March*, 1942.

Mitchell Victory

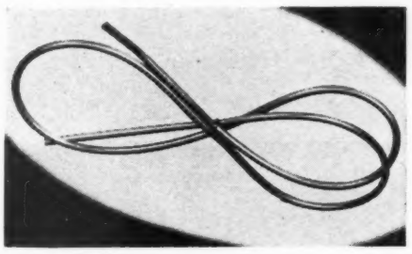
Latest Mitchell contribution to war production is "The Victory" a new fluorescent industrial light featuring porcelain enamel reflector of one-piece, seamless, non-welded construction, made by **Mitchell Mfg. Co.**, 2525 Clybourn Ave., Chicago, Ill. The two models, No. 2034, with two 40-watt fluorescent bulbs, and No. 2035, with three 40-watt bulbs,



are high intensity, high efficiency units, ideal for high lumen per watt performance. A 13½ degree cut-off eliminates glare. Reflector is quickly detachable from housing, making it easy to service. Power Factor corrected. Latest approved ballasts and starters; 110–125 volts, A.C. 60 cycle. Also available for 50 cycle operation, or for 220–250 volts. Both units are Fleur-o-liers and approved by Underwriters' Laboratories. —AVIATION, *March*, 1942.

Brand Turbo Tubing

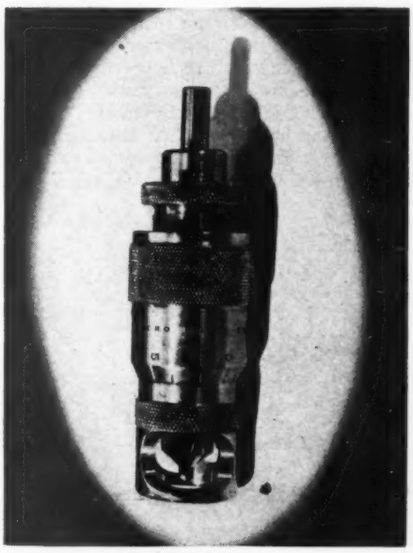
Said to successfully attain its objective —resistance to extremely low temperatures—the new turbo extruded tubing for electrical insulation by **William Brand & Co.**, 276 Fourth Ave., New York, N. Y., withstands extremes of 30 to 40 deg., below zero. High dielectric strength (23,800 volts); tensile strength of 3140 lb./sq.in.; and elongation factor of 255 percent at break two-inch gage length should make this tubing valuable equipment. Its moisture absorption factor is less than ½ of one percent in 24 hours of water immersion, and insured retention of its original shape and size is obtained by resiliency to heat and cold variations, company announces. Variety of colors in standard A.S.T.M. diameters of 36 in.



lengths, or coils of continuous length in minimums of 25 ft.—AVIATION, *March*, 1942.

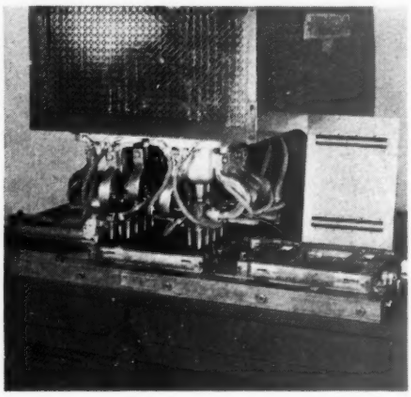
Aero Tool Countersink

Positive countersinking to predetermined depths and to tolerances of .001 is now possible with a new Micrometer Stop Countersink recently prefected, according to manufacturer, the **Aero Tool Co.** of Burbank, Calif. This instrument was specially intended for use in aircraft manufacturing and is said to permit greater precision accuracy than hitherto obtainable. Adjusted by slight thumb pressure, it is claimed that Aero Tool Micrometer Stop Countersink cuts smoother, more accurate holes for flush rivets and screws without marring the metals. Unique spring loading device locks it rigidly in desired micrometer position eliminating chattering and walking and preventing heat from friction. Ball thrust bearing assures smooth even operation. Cutters are available at ⅜ and ½ inches in diameter either at 82 or 100 degrees.—AVIATION, *March*, 1942.



Progressive Welder

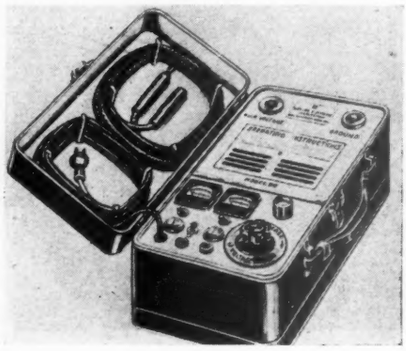
For speed in your defense production **Progressive Welder Co.,** E. Outer Drive, Detroit, Mich., has evolved a new Hydromatic Welder. This welder of reinforcements in ammunition box ends, incorporates an unusual fixture shuttling mechanism. At right of fixture is assembled part, the job being to weld channels to flat plate. With fixture at right, channels and box end are dropped in place and clamped. Fixture shuttles to left below welding point, where sixteen welds are performed automatically.



During assembly welding, left end of tool moves left of welding head, and an assembled box end is removed and parts for another clamped in place. The device then shuttles back to right and second finished assembly is taken out. Thus, only two stations are necessary, in spite of two loading positions and one welding position, and no time is lost in loading. Announced production is 300 assemblies per hour.—AVIATION, *March,* 1942.

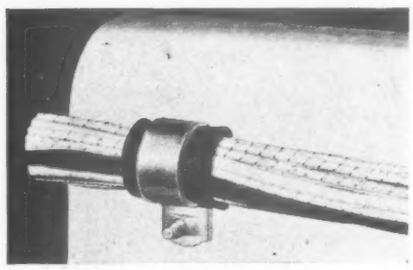
Slayter Rectifier

Light weight and small size of this **Slayter Electronic Corp.** (Newark, Ohio) rectifier combine to make a portable, safe, rugged unit company says. Polarity of the unit can be reversed in a few minutes, units can be turned on and used at once, without waiting for "warm up" and can be operated continuously on full load. It cannot be damaged by direct shorts from high voltage terminal to ground, and shell type collecting electrodes in tubes make it easy to cool units at higher power ranges. In addition to low "first cost" the Slayter units are said to be economical to operate. Contained in a grounded metal carrying case, all necessary metering devices of the rectifier are built in as an integral part of the case.—AVIATION, *March,* 1942.



Bendix Kwik-Klips

Called the Kwik-Klip, a new fastening device has been added to its line of cushion and bare clamps by **Bendix Aviation, Ltd.,** North Hollywood, Calif. Designed to save labor on wiring, conduit and tubing installations, the Kwik-Klip is constructed as a half loop and merely fits over the wire or conduit—is not bolted to it. Installation is unusually fast as it is only necessary to secure the Kwik-Klip to the airplane structure or other member by means of a screw through the single mounting hole. Kwik-Klips are supplied with or without Speed Nuts and with or without Neoprene cushion. When the Neoprene cushion is supplied it is permanently bonded to the clamp by the exclusive Bendix Thermo-Weld process, doing away with the need



for wrapping wire or conduit with tape for protection at the point where the clamp is applied. Kwik-Klips are supplied in sizes ranging from ⅛ in. to 1¼ in. I.D.—AVIATION, *March,* 1942.

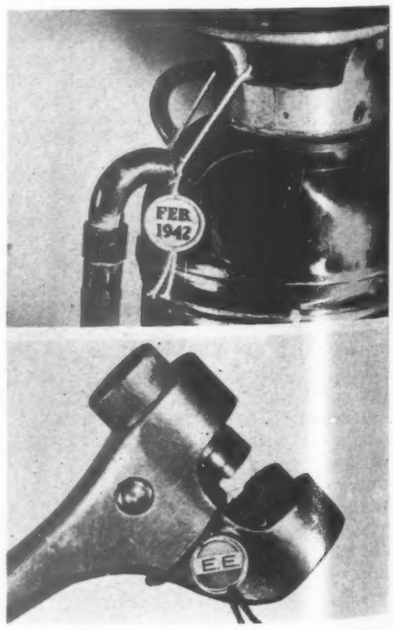
Michigan Tool "Sine-Line"

For checking right and left hand spiral gear leads from zero to infinity a new "Sine-Line" lead checking machine, Model 1205, has been constructed by **Michigan Tool Co.,** 7171 E. McNichols Road, Detroit, Mich. This new machine, adjustable sine-bar type, eliminates need for master rolls, discs or lead screws in checking gears and can be used with Michigan gear checking recorder. Gear size capacity is zero to 18 in. diam., with 24 in. between centers. Bed lengths 36 and 48 in. available at extra cost. This appliance features maximum rigidity and complete dust protection. "Friction rolls" provide two ratios of spindle to the sine-bar table. Selection of proper set or rolls is made by moving a lever under cover enclosing sine-bar table. The two ratios provide for all diameters and lengths of gears within operating

range of the machine. Indicator pedestal can be swung from left to right for checking either face of gear teeth.—AVIATION, *March,* 1942.

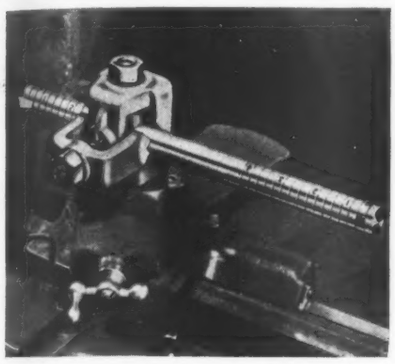
Stoeffel Seals

Unlike the old-fashioned lead seals, Stoeffel Seals are 100 percent tamperproof, it is claimed. Made of two components—pre-shaped metal seal-cup and identification disc, multicolor-printed—once these two parts are locked no tampering is possible without immediate detection. Made by **Stoeffel Seals Co., Inc.,** 188 Water St., New York, N. Y., these seals can be permanently applied with either string, thin cord, or two-ply wire, whichever is most suitable to sealing operation with the Sealing-Pliers. Basic colors may indicate time element, process, location or priority of sealed object, etc. Further markings such as inspector's numbers can be incorporated in Sealing Pliers, so that at moment of closing pliers, the number or mark is indented into the disc.—AVIATION, *March,* 1942.



P. M. Cable Splicer

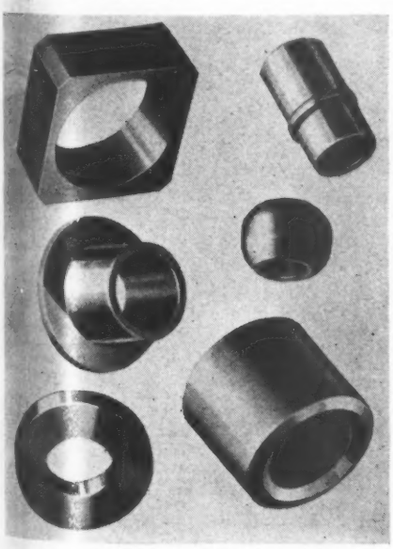
It is claimed that a more efficient splicing job can be done with the P.M. Universal Quick Adjusting Cable Splicer prepared by the **Patrick-McDermott Co.**, Los Angeles, Calif., for aircraft cable splicing. Its knurled adjusting mechanism can be manually operated to accept



cables of from 1/16 to 1/4 in. without use of adapters. When placed in a vice, the P.M. Cable Splicer is easily adjustable from a rotating position to a positive position and does not need to be removed during the process. The tool is light in weight (1 lb.) and compactly constructed of high grade steels.—AVIATION, *March*, 1942.

Keystone Carbon Bearings

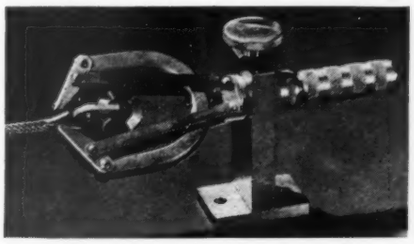
The Keystone Carbon Co., Inc., 1935 State St., St. Marys, Penna., has added Selflube porous iron bearings to their line of self-lubricating bronze bearings. Stronger than porous bronze bearings and interchangeable with them in most applications, these new bearings have been perfected after years of research. Powdered iron molded to size and shape desired, then baked, saturated with good grade oil produces bearings which have an average porosity of 25 to 35 percent.



This porosity permits a reserve of oil that sometimes lasts the entire life of the application. A low friction coefficient, together with self-lubricating qualities, prevents excessive temperature, speed reduction, noise and scoring of shaft. Molded to close dimensional tolerances, as in the case of Selflube porous bronze bearings, no re-designing or special engineering is required.—AVIATION, *March*, 1942.

Mechanics Engrg. Splicer

Designed for use in aircraft work, the Universal Cable Splicer, made by **Mechanics Engineering Co.**, Box 243, Jackson, Mich., employs a flexible band of tempered spring steel, faced with leather which wraps around the work being held and insures complete and even "snugging" of cable to thimble or bushing. By this method no looseness of fixture is possible when the splice is complete, it is claimed. Clamped to bench or in a bench vice, holder maintains splicer in



any position throughout 360 degrees, or permits quick removal of implement if portability is desired. For thimbles and bushings carrying cables from 1/16 in. diam. to 3/8 in. diam. a variety of adapters is furnished — quickly interchangeable without use of instruments.—AVIATION, *March*, 1942.

WINDOW SHOPPING

The Lincoln "Shield-Arc"—Clever arrangement of charts and photographs showing details and incidentally, the drama) involved in the process of arc welding with aid of "Shield Arc". Time-cutting, cost-saving developments described. Last page lists variety of Lincoln equipment with special purpose of each. Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio.

More Output for Defense—Interesting photographs taken in defense plants showing variety of operations now making use of Reeves variable speed control units. Adequate explanations. Reeves Pulley Co., Columbus, Indiana.

Toledo Scales for Aviation Industry—Four page pamphlet, with detailed photos of more than a dozen new pieces of weighing equipment for aviation use. Concise descriptions. Toledo Scale Co., 1022 Telegraph Rd., Toledo, Ohio.

Everdur—Four color folder with sketches showing some war time uses of "Everdur," copper-silicon alloy. American Brass Co., Waterbury, Conn.

Laminum—Instructive booklet covering history of development of laminated shim since founding of company. Describes use of this type of shim for fitting of machine parts in original assembly as well as for making service adjustments. Laminated Shim Co., Inc., Union St., Glenbrook, Conn.

Ex-Cello-O Tool Tips—Profusely illustrated with photos of Ex-Cell-O Universal Fixtures at work, and close-ups of numerous parts, bored, turned, faced, or grooved on Ex-Cell-O Precision Boring Machines with use of the Fixture. Authorized chart of progress of U. S. business for past century and graph of U. S. machine tool production from 1929 to date. Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit, Mich.

Gatke Fabric Bearings—Practical presentation of all types of Gatke Molded Fabric Bearings with photographs of nearly every one. Operating characteristics and performance results clearly defined. Gatke Corp., 228 N. La Salle St., Chicago, Ill.

Weltronic "Trans-Ceiver"—Bulletin T-42 in four pages deals with operation, range power, construction and some potential uses of this combination radio-telephone unit. Illustrations demonstrate proper handling. Communications Div., Weltronic Corp., 3080 E. Outer Drive, Detroit, Mich.

Magnus Technical Bulletin, No. 51—Comprehensive instructions on how to protect hands and arms by safe, effective cleaning methods. Recommended for every plant manager concerned with control of industrial dermatoses. Magnus Chemical Co., South Ave., Garwood, N. J.

How Light Can Help—Logically developed, emphatically written treatise on importance of proper lighting as an integral but often unrecognized part of national defense. General Electric Co., Nela Park, Cleveland, Ohio.

Blackout Twins—Brief booklet describing interior and exterior grade of Blackout Cold Water Paints, to be mixed with water and applied by brush or spray. Tamms Silica Co., 228 N. La Salle St., Chicago, Ill.

More Minutes per Hour—Data sheet explaining qualities of Ampco Grade 18 Metal which fit it for service under severe operating conditions. Specific example of machine equipped with Ampco Grade 18 illustrated and its operational advantages described. Ampco Metal Inc., 1745 S. 38th St., Milwaukee, Wisconsin.

Bendix Bulletin—Partial standardization covering existing hydraulic cylinder designs. Twenty-six types of cylinders with bore, stroke, rod size, type of clevis, length compressed and extended, port size, lock equipment and weight given. Bendix Aviation, Ltd., North Hollywood, Calif.

Fedders Series 4—Information on new line of Lo-Temp Unit Heaters, compactly assembled with helpful outline drawings, photographs, capacity and dimensional data. Fedders Mfg. Co., Inc., Buffalo, N. Y.

Magic Bottles—Explanatory text on compressed gases applied to fire fighting equipment in aircraft. Exceptionally valuable reading at this time. Walter Kidde & Co., Inc., 140 Cedar St., New York, N. Y.

Type R-2 Rotary Switches—Instrument, control and auxiliary R-2 Switches defined to the last detail in table, text and diagram. Excellent for the most exacting engineer. Roller-Smith Co., 1756-1770 West Market St., Bethlehem, Pa.

Roper Rotary Pumps—Facts and figures, graphs and charts, even an index, on Roper Rotary Pumps. This spiral bound, well-made book should bear up nicely under much passing about in the plant. Geo. D. Roper Corp., Rockford, Ill.

Bakelite Sealing Solutions for Porous Castings—Directions for reclaiming metal and alloy pressure castings, instructions for impregnation of castings and baking operations, conveniently presented in four-page folder. Bakelite Corp., 30 East 42nd St., New York, N. Y.

AVIATION'S

SUBCONTRACTORS SECTION

IN THIS NEW SUBCONTRACTORS SECTION, Aviation offers a service designed to simplify the search for outside manufacturing facilities and thus speed the process of subcontracting.

The production goal of 60,000 military planes during 1942, and 125,000 in 1943, is one of the greatest industrial projects of all time, involving a vast expansion in subcontracting.

It is the purpose of this section to serve as a meeting-place between prime contractor and subcontractor.

Here, manufacturers desiring subcontract work from the aviation industry can make known their facilities, capacity, and ability to serve.

Here, subcontracting facilities may be quickly brought to the attention of firms who urgently need them.

The pages of Aviation have long served as a meeting-place for prime and subcontractors, and we believe this new section will render a greatly needed service demanded by our war-time aircraft program.

EFFECTIVE HELP

to Aviation's All-Out Effort

DUNBAR GLASS PLANT AND PRODUCT

PLANT FACILITIES

Covering a 22-acre tract are units comprising: Complete assembly shops, modern machine shops, pattern shops, tool rooms, etc.

By ingenious arrangement a flexibility is secured so that production may be swiftly altered as to types of glass production.

Facilities are thoroughly modern and our 750 workers are skilled workers.

★

PRODUCTION

Lime-soda glass, in crystal colors, and Borosilicate (heat resist) glass.

Production at present is pressed and blown glassware of a handmade variety and also semi-automatic.

These are supplied to manufacturers for use in their finished products.

★

DESIGNING FOR AVIATION

In considering glass as an aviation material—how it is worked, how machined, its use as mechanical parts, we shall gladly supply you with facts and figures.

From such data you may establish the variations of hand and machine blown ware, hand pressed and machine pressed ware, the temperature ranges of all types of glass, together with all physical properties for comparison with materials less available.

★

THE facilities afforded aviation engineers here at Dunbar are rather unusual.

First, as to plant: It is large—covering 22 acres and MODERN.

Second, but first in importance, is a practical and tested flexibility to alter its type of production with greater SPEED and INGENUITY than has been deemed possible. Third, a force of 750 workers, skilled in this rapid production of glass parts for fabricators of finished products in metal, plastic, wood and other materials.

Fourth, the types of glass in which this force is skilled are lime-soda glass, in crystal and colors, and borosilicate (heat resist) glass.

That these facilities may be applied to your present problems (which are many), mail us a sketch—or inquiry as to glass application to a specific part—or for information on designing for glass.

DUNBAR GLASS CORPORATION

DUNBAR, WEST VIRGINIA

America At War

(*Continued from page* 53)

with what Mr. Batt says.

At the same time some Congressmen, who have access to all the information there is, are saying that those responsible for our safety have been remiss in not pushing our air forces harder than they have. Particularly, we should have concentrated more than we did on torpedo and dive bombers, they say.

But Congressmen, with all their information, get confused, just as the rest of us do. Senator Harry S. Truman, who had a truck-load of dope, wrote a report, as you may know, charging the Army and Navy and the aircraft industry with failure to develop superior airplanes, and with giving away what good ones we did have. Then Rep. Dow Harter wrote another report, showing that Mr. Truman was wrong. Mr. Truman's report fell pretty flat in the first place, considering all the advance billing it had.

On the Atlantic side of the war, we find less air action and even more uncertainty than in the East. Why the British did not carry out their threat to shake Europe with bombs during the long winter nights, we still don't know. Presumably their production of long-range bombers is continuing, and even increasing. So, even though deliveries of American planes to Britain may have all but stopped, they could sweep Europe if they wanted to. Is it possible that bombing towns and ground works is not worth the cost? Are they saving their planes for the day when the mad Hitler, wounded by the Russians, charges them again?

Likewise on the Russian front there is little air activity. But the reasons are different. Air war on the blizzardy tundras simply froze up. By grapevine comes word that the Nazis, with vegetable oil for lubrication and synthetic gasoline, have one awful time. And the Russians, even though they have good oil and gas, don't do much better.

So the Russians and the Germans and the British would seem to be saving up airplanes at a total rate of maybe six or eight thousand a month. If so, they should be able to put on a lively scrap, come spring. And, if the Russians can take enough ground to get within reasonable bombing distance of Germany, Hitler will be getting it from both front and rear. Italy is so low in the aircraft production picture that she is rated hardly more than a nuisance—by Hitler as well as Churchill.

Here at home, Congress is supporting the President's program with appropriations big enough to buy some of the belligerents and have change left. These vast funds make breathless reading, but, as we have said before, they don't mean a thing. The credit of the United States hasn't turned a hair, yet, and all that counts is production capacity.

The biggest technological show in the world's history is going on right now in Detroit, headed by a pleasant-looking, middle-aged man named Ernest Kanzler, who used to be a Ford production vice-president. Mr. Kanzler is stopping the wheels of the mighty automobile industry long enough to re-tool the machines, so that airplane parts, airplanes, guns and tanks will come out of the spout, instead of cars. He reports only to Donald Nelson, chairman of the WPB, who reports only to the President.

Behind a screen of secrecy Mr. Kanzler is passing the miracle of the 20th century. Or rather, Kanzler, being only human, is the symbol of a group of men who are doing it. They represent all the technical knowledge accumulated since time began, which is available to anybody; but they have, in addition, the American genius of doing things in a big way.

The facilities of the auto industry, and of the airplane industry, may be completely scrambled before this job is

(*Turn to page* 125)

From the Fight to the Factory

Pursuing the policy of keeping America's workers informed of the part their handiwork plays in carrying the fight to our enemies, Assistant Secretary of War for Air, Robert M. Lovett, sent these heartening messages on the occasion of brilliant actions by U. S. Airmen in the desperate struggle for the Netherlands Indies.

Bureau of Public Relations
February 23, 1942

Employees of the Douglas Aircraft Co., Santa Monica, California

Here's a message from the fight to the factory, a flash from Lieutenant General George H. Brett, Deputy Supreme Commander of the Allied Forces in the Southwest Pacific. "American aircraft participated in continuing and damaging attacks on Japanese war fleets off the coast of Bali. A formation of seven American Army Douglas A-24 dive bombers escorted by fighter planes swooped down on an enemy fleet consisting of two cruisers, four or five destroyers and four transports and seriously damaged a Jap cruiser. Earlier four enemy fighter planes were shot out of the sky by our heavy bombers supported by two Douglas A-24's without loss to our aircraft." Credit for these operations must be shared by you men and women.

LOVETT
Assistant Secretary of War for Air

Bureau of Public Relations
February 3, 1942

Employees of the Curtiss Wright Corp., Buffalo, New York

U. S. Army pilots flying Curtiss P-40 fighters are getting tough assignments over the Netherlands Indies. Last week sixteen of them intercepted twenty-five heavy Japanese bombers and two fighter planes over Java. Our pilots destroyed five of the enemy bombers and one fighter. We lost one plane but the pilot parachuted to safety. Nine other Curtiss fighters intercepted six Japanese pursuit planes over Java, shooting down four. Then they kept right on to a Japanese held air field in Sumatra and despite intense anti-aircraft fire bombed installations there. All returned safely to their base. Credit for these operations must be shared by you men and women who made these planes. You keep on giving them to us and we'll keep on fighting them.

LOVETT
Assistant Secretary of War for Air

PLASTIC PLYWOODS FOR AIRCRAFT

A Complete "Service of Supply" for All Your Plywood Requirements.

FABRICATED PARTS and PANELS

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Hollo-*Tech* **Metl-*Tech***

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ARMY and NAVY
Specifications
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Bulkhead Connectors

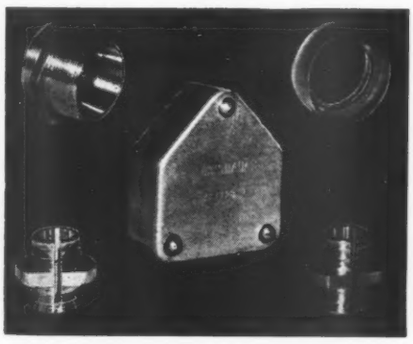
Coupling Nuts

Elbows

Locknuts

Box Connectors

Junction Boxes



CONDUIT FITTINGS

For the Aircraft Industry

UNIONAIR

UNION AIRCRAFT PRODUCTS CORP. — A UNION R

From inspection of raw material and continuing through the process of manufacture to final inspection, our inspectors are constantly on guard against any relaxation of the high standards we have set.

And we shall continue conscientiously and energetically to build our products to meet the rigid specifications required by our Army and Navy.

UNION AIRCRAFT PRODUCTS CORP.

General Offices and Factory
380 SECOND AVENUE
NEW YORK, N. Y.

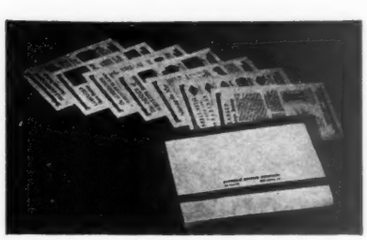
JOHNSON BRONZE

SLEEVE TYPE BEARINGS

for any type AIRCRAFT

For the
ENGINEER

Bearing data sheets that cover all the fundamentals of sleeve type bearings such as Design, Alloys, Lubrication, etc. Write for your free copy.



◆ Sleeve type bearings for modern aircraft require new, high standards of precision and accuracy. This is true of all planes from the giant bombers to the "grasshoppers" and likewise true of all aircraft equipment.

It was an easy matter for JOHNSON BRONZE to meet the rigid requirements of the aircraft industry. Our complete facilities plus our more than thirty years exclusive bearing experience enabled us to do the job RIGHT . . . from the start.

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SIDE SLIPS

• THE INTREPID AVIATOR was in the office the other day considerably worried—in fact he hadn't stopped worrying after finishing up six of our best cigars. His concern was over the safety of the original Wright Brothers' Airplane, supposedly stowed away with ample protection somewhere in England. As no one seems to know just what constitutes ample protection now-a-days, what with rapidly changing war tactics, he had a suggestion to make just after lighting the last cigar. As the aviation cycle of development is now just about back to the arrangements with which the Wright Brothers started, judging by items and pictures in the papers—pusher propellers, tail surfaces forward, catapult take-offs, liquid-cooled engines, square tipped airfoils, wooden construction, and so on, he couldn't see why it shouldn't be flown back to this country. The only difficulties he could forsee would be the possible need of an additional underslung tank to give the original airplane a little more range and to obtain sufficient low-test gasoline.

• INCIDENTALLY, the Intrepid Aviator said he was going to run a research, with the aid of his side-kick, the Sterling Mechanic, which he was sure would be of great aid to our government. The main idea of all nations at war appears to be to use substitute materials wherever possible—gasoline should be made out of corn stalks or mock oranges, even though gasoline is available, as the gasoline has to be made into skim milk by a secret process, which in turn is made into imitation silk stockings and corn cob pipes. In other words, comes a war, it isn't considered cricket to make anything out of the same old material, even if it is available. For example, office desks are now made of steel so that wood will be available to make certain airplane parts which were formerly made out of steel. Considering the experience of the Intrepid Aviator and the Sterling Mechanic in the use of substitute materials, in their barnstorming days after World War I, we are looking forward to this report with much interest. We understand that in those barnstorming days they even had a substitute for money.

• THERE is one interesting development which has come about as a result of this war. Practically all of the aeronautical people we know are busy buying farms (ranches on the West Coast) and all farmers and ranchers seem to be flocking to the Defense plants for the jobs offered. Having worked in both lines of endeavor we think the farmers are the smarter of the two. In a factory they get extra pay for the longer hours of overtime, whereas long hours on the farm involve only a "misery" in one's back and another mortgage.

• IN ANY CASE we're glad we didn't get that beachcombing job on a South Sea Island "for the duration." We'd have been bothered by a lot of Jap landing parties (as we relaxed in the shade of our breadfruit trees and banana palms) and in a short time would have been bothered again as the same Japs were chased off the island into the surf.

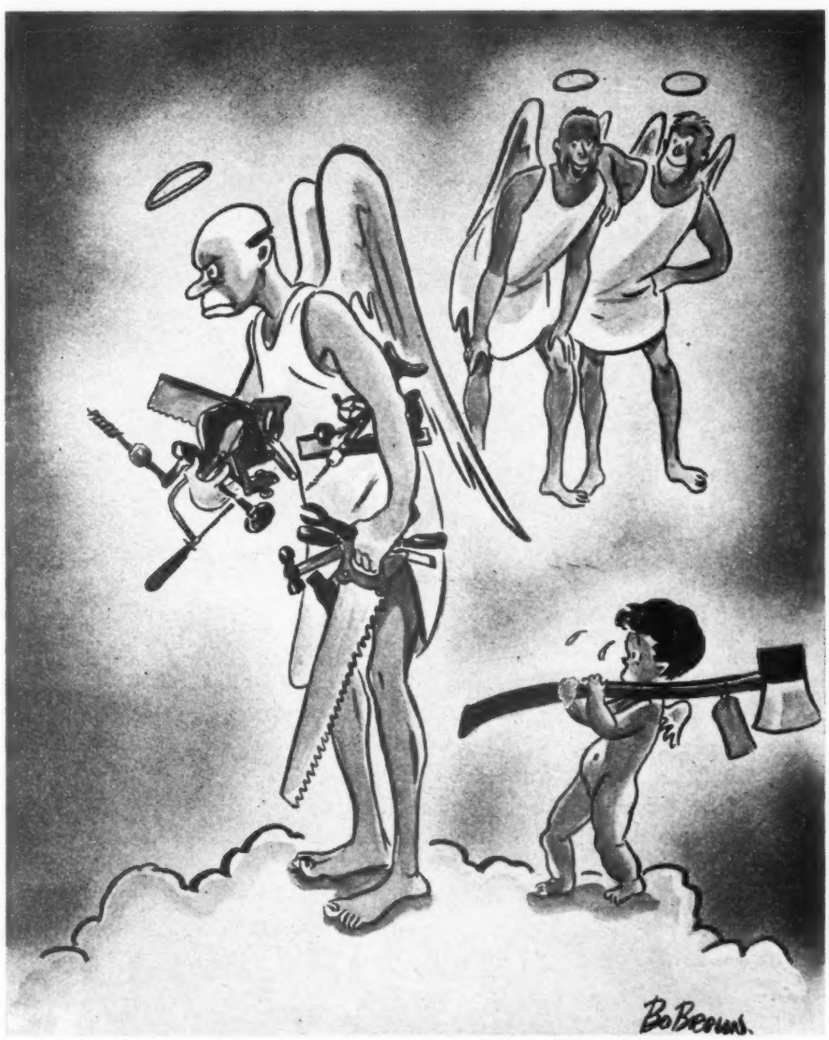
However, we're still looking for someone who wants a passenger willing to pay part fare on a rocket trip to the moon.

• WELL, there was one bit of weather news which got by the Censor, and just as well, too, as it isn't going to give any comfort to the enemy. The newspapers printed the fact that the ground-hog at Quarryville, Pa., had seen his shadow on Feb. 2nd, indicating that there were going to be six more weeks of winter weather. If all continues as it has been going on the Russian front during winter we think the Germans will welcome the first violet of spring with much joy.

"DESIGNERS FASHIONING AIRPLANES LIKE BATS"
Buffalo Evening News Headline

• WE RESENT that implication Sir! Our seconds will call on your seconds tonight. We'd slap your face with a

(*Turn to page 120*)



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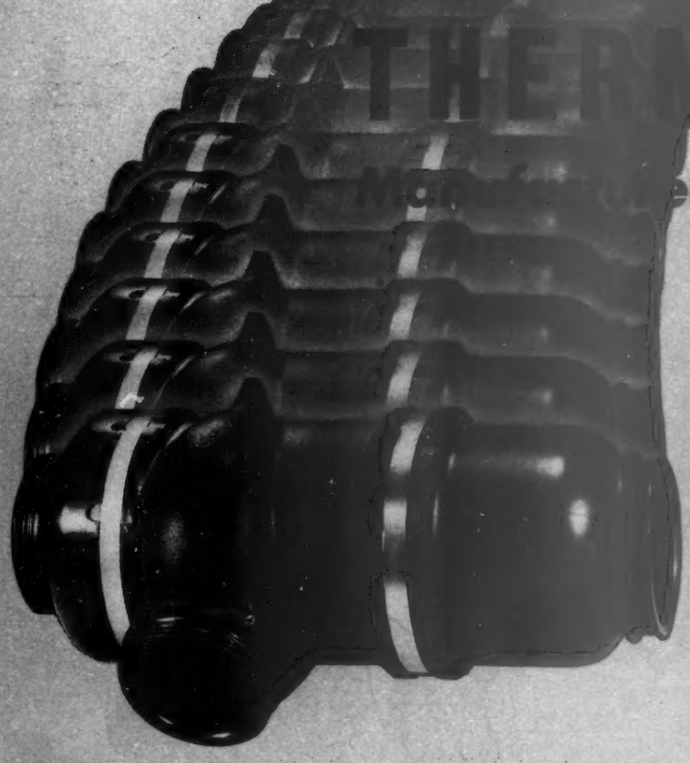

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Aviation's Constant Adjustments

By SELIG ALTSCHUL

IT IS well established by now that one of the permanent aspects of aviation is its ever-changing character and adjustment processes.

The aircraft builders no sooner complete one expansion program when another is thrust upon them. Further, certain co-ordination must be made with the automobile and other non-aeronautical groups contributing to the aircraft effort. Strangely enough, the aircraft builders have never known a period which may be considered "normal" in the same sense experienced by other industrial groups in their development.

These constant adjustments take a heavy toll of earnings and in some cases vie with mounting taxes as a factor in reducing corporate income.

Despite the volume of business at hand, aircraft equities continue to show reactionary tendencies thus far in 1942. While the general market has also been weak (with the exception of railroad issues), the aircrafts appear to be doing worse than average. The relative trends are indicated by the accompanying averages.

Interestingly enough, many aircraft issues are now selling at lower levels than in pre-war days when a receipt of an order for 25 planes was an historic event in the life of any company. For example, out of 9 leading aircraft issues, only one—Consolidated Aircraft—made a record high in 1941, the remaining 8 are far below their best prices. Table I.

The poor performance of the group may be attributed to a combination of factors. The excess profits tax places a definite ceiling upon earnings so that little if any benefit will accrue to the manufacturers by virtue of the huge program under way. In fact, earnings this year may be reduced for most companies by even higher taxes.

Even if disarmament does not occur at the conclusion of hostilities, the United States and its allies will have on hand so many military planes that new large orders may dry-up completely for a considerable period, thus bringing in its wake serious adjustment problems in the disposition of plants and personnel now identified with the aircraft industry. While the demand for commercial planes will ultimately be very large, the near-term requirements will hardly absorb the huge capacity of the builders.

The participation of the major automobile combines in the manufacture of planes and aircraft engines may be a source of future competition. Yet, it is possible that the automotive companies may find cause for nervousness in the new mode of transportation that may evolve after the war in which the airplane may supplant the automobile. In any event, these two industrial groups may find themselves in each other's pastures.

The air transport equities continue to give a consistently better account of themselves. This has been noted in previous issues and is merely a reflection of the favorable position of the industry during the present emergency and its outlook in a post-war world.

The air lines have again successfully hurdled another of the adjustment processes so common in its ebullient history. In the fast moving events following December 7, much confusion prevailed as to the status of the air transport industry in a war period. This problem had long been defined and during the defense period preceding the war, the air lines had given a tangible demonstration of their contribution to the armament drive. Despite many military developments, it appears fairly certain that airline operations, for the most part, will continue along normal channels with independent ownership and control. The establishment of mandatory priorities on space by the War department merely gave official force to a policy that had been voluntarily pursued by the industry in the past.

With the exception of the Stratoliners removed from TWA (which were replaced by other planes), no equipment withdrawals were made from the air lines. In fact there is now good reason to believe that the industry may receive additional equipment originally scheduled for delivery this year.

While a military reserve pool has been formed from the 2,200 odd pilots, it is considered unlikely that this group will be pressed into active combat service. Here, too, it has been found more desirable and in the best interests of the war effort for the air lines to maintain normal operations.

The newly-created Office of Defense Transportation has also indicated no desire to interfere with the established function and procedures now followed by the air transport operators.

It was in this clearing atmosphere that investor confidence was restored to air transport securities after a temporary period of nervousness. However, a certain degree of uncertainty will continue to prevail by the issuance of examiner's reports recommending reduced and retroactive mail compensation. The Eastern report is a case in point and may be attributed as the chief factor in the decided weakness of this company's stock. The full CAB, however, is expected to pass on the American examiner's report in regard to retroactive mail pay adjustments and may clear the air with a precedent-setting decision.

The Eastern report also recommended the pound-mile method as a basis of compensation to supplant the present plane-mile system of pay. If confirmed by the CAB, this new basis may be applied to other major airlines and will represent a fundamental adjustment in mail rate regulation.

An examination of the portfolio holdings of the country's investment trusts affords an opportunity to ascertain how this important group of capital views the outlook for aviation securities. Table II presents the aggregate aviation holdings of 40 general investment trusts—

TABLE I—Market Prices of Leading Aircraft Issues at Their Record Highs and at Current Levels

	Price Feb. 6, '42	Record High	Year of Record High
Bell Aircraft	15¼	37¼	1938
Boeing Aircraft	17½	49½	1937
Consolidated Aircraft	18	23½	1941
Curtiss-Wright	8	13¾	1939
Douglas Aircraft	63½	95	1940
Lockheed Aircraft	21¼	42	1940
Glenn L. Martin Co.	22½	47½	1940
North American Aviation	12	29¼	1939
United Aircraft	30½	53½	1940

Note: All prices adjusted to nearest quarter of a point.

TABLE II — Aggregate Aviation Holdings of 40 General Investment Trusts as of December 31, 1941

	No. Trusts Holding	Total Shares Held
AIRCRAFTS		
Bell Aircraft	2	2,300
Boeing Aircraft	3	2,900
Consolidated Aircraft	2	3,700
Curtiss-Wright—(Common)	3	31,100
" " —("A")	6	68,700
Douglas Aircraft	11	8,600
Lockheed Aircraft	9	26,100
Glenn L. Martin Co.	12	23,400
North American Aviation	3	29,600
Sperry Corp.	8	40,000
United Aircraft	22	81,100
AIR TRANSPORTS		
American Airlines	15	38,900
Eastern Airlines	18	44,600
Pan American Airways	12	109,900
Penn-Central Airlines	2	3,400
Trans. & Western Air	1	2,200
United Air Lines	16	67,400
AVIATION TRUSTS		
Aviation Corp.*	3	107,675
National Aviation**	2	26,700

* Includes 80,775 shares held by Lehman Corp.

** National Aviation owns a wide and diversified list of aviation securities in its portfolio which are not included in the above tabulation.

believed to represent the bulk of such funds as of December 31, 1941.

In looking at this composite picture, it is pertinent to note that in the past the best investment trusts have made mistakes on individual issues as well as upon major market trends. Also, it is difficult to determine when a particular commitment was made and if a change has not since occurred. Further, a management's policy in respect to individual investments is frequently affected by the trust's other holdings.

Within these general limitations, significant observations may be made. For purposes of simplicity, the accompanying table shows aviation holdings as of the last year-end with the number of trusts owning each issue. This and supporting material discloses that aircraft shares are among the least popular of trust holdings and a gradual reduction in this group is constantly taking place. On the other hand, a few of the air transport issues have been singled out for concentrated purchases.

United Aircraft with aggregate holdings of 81,100 shares by 22 trusts remains the favorite aircraft issue. Trust managements invariably seeking diversification in all respects probably regard this company well-situated in this respect. Curtiss-Wright, the other completely integrated aviation unit, finds a few but substantial supporters for its "A" stock. This issue has been paying a regular $2.00 dividend and has provided a conservative return—thus meeting with favor.

An examination of the general changes in other aircraft issues merely confirms the belief that trusts have been sellers of this group with no change in trend indicated.

A number of interesting trends are evident in the air transport issues. The potentialities of this group have been more widely recognized than ever before as indicated by the large number of participating trusts. It is significant, too, that among the domestic companies, only the major lines have come in for attention. Such concentration is nothing more than belated recognition of progress already made and does not particularly credit investment managements with foresight. As a rule, trusts like to confine their commitments to issues which have become "seasoned."

At times, it becomes difficult to follow the investment philosophy of these funds as disclosed by their action. For example, when Eastern Airlines was first offered in 1938 at around $10 per share, there was hardly any trust interest in this issue whatsoever. Now, following years of progressive earnings—resulting from a favorable monopoly condition—and after accomplishment of the fact, Eastern has become a favorite of trust managements at better than three times its offering price. This buying was done in the face of an adverse examiner's report on American's mail rates and which ultimate determination will have a bearing on Eastern. More important, it was common knowledge that a similar report was to be issued on Eastern. And it was—with the result that the stock broke badly—after the investment trusts had loaded up heavily on Eastern. It is possible to conclude that these fund managers have faith in ultimate favorable decisions by the full CAB in passing upon retroactive and reduced mail pay as recommended by the examiners. Perhaps so—but any group which makes a fetish in being so conservative could have been a little patient this past year, at least insofar as Eastern was concerned.

If investment trust conservatism is something to be stressed in the prospectus but not applied in practice, why not some encouragement to the less-seasoned airline equities which really need support. While many of the smaller airlines have outstanding growth possibilities they continue to lack an investment market. It is in this group of the smaller lines where investment trusts could be performing a constructive service—and be amply rewarded by discerning action—in providing some of the equity funds so necessary in a growing industry.

American, Eastern and United are the popular choices among the domestic air transports. TWA is conspicuous by the minor participation in its stock by a single trust. However, TWA need not have any concern as it has one of the best investment supports of all in the Hughes Tool Co. which last reported holdings of 432,250 shares or about 46 percent of the total outstanding. Nor has lack of trust interest precluded the company from obtaining a substantial line of credit from a group of banks—at 2¾ percent interest.

Pan American Airways appears to be in great popularity with many of the more substantial trusts. There is nothing picayune about these commitments: 20,000 shares by Lehman Corp., 18,600 each by National Investors and Blue Ridge, 18,000 by Incorporated Investors and 16,500 by Massachusetts Investors Trust. These trusts and others, are merely confirming the investment judgment the United States has in Pan American. The Government, too, has some substantial commitments in Pan American. Not only has the company received substantial mail subsidies but has leaned heavily on federal assistance for other measures as well. As a matter of interest, from 1928 to the end of the 1942 fiscal year, approximately $123,000,000 has been appropriated for U. S. foreign air mail routes—virtually all of which may be allocated to Pan American. It is also noteworthy that the company has drawn upon special defense funds to build and enlarge airports and other facilities in Latin America and Africa. While these augmented facilities are available to the U. S. Army and Navy, they probably will remain in possession of Pan American Airways at the conclusion of hostilities.

It is significant that none of the combined trust holdings exceed 10 percent of the outstanding stock of any one aviation issue. Those issues in which more than 5 percent were held, included American Airlines, Eastern Air Lines, Pan American Airways and Curtiss-Wright "A".

Aviation holdings—both aircrafts and air transports—never bulked as large among aggregate trust investments as they did this past year-end. Present trends indicate that such equities as air line securities may become increasingly popular among investment fund managers. This policy may not only prove worth-while but it also identifies management in the eyes of the trust stockholders, as being progressive and being aware of new and growing industries. All this may be very helpful to the air transport industry as it may make future financing that much easier.

Barron's Stock Averages

	Aircraft	Air Transport	50 Stocks
February 6, 1942.....	31.82	20.94	64
January 30, 1942.....	32.25	20.97	64
January 23, 1942.....	32.82	20.53	63
January 16, 1942.....	33.78	20.31	65
January 9, 1942.....	34.28	19.56	64
February 7, 1941.....	35.22	22.31	73

Side Slips

(*Continued from page 117*)

glove if we had the proper priority to buy a pair of gloves. May we suggest pistols for two and coffee for one, under the "duelling oak" tomorrow at dawn?

• WE SAW by the papers that four American pursuit ships shot down twenty German modern fighters and bombers in one battle about a month ago. The American public shouldn't be discouraged by this report, as the pilots probably were not thoroughly familiar with flying the American ships at that time.

• NOTING that the British have renamed American airplanes to be Curtiss "Mohawks" and "Tomahawks," Brewster "Buffaloes" North American "Mustangs" and so on, it appears that the old English idea still exists; that this country is mostly in possession of the Indians.

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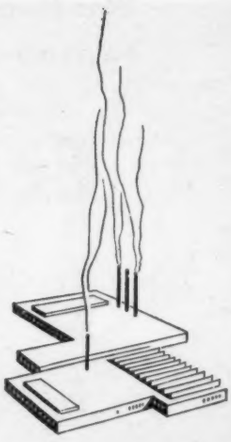

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5 H. P. and Smaller ELECTRIC MOTORS FOR AIRCRAFT 5 H. P. and Smaller

By J. I. WADDINGTON

M.A., A.F.R. Ae. S.

War-time repair and maintenance organization of R.A.F. geared to combat requirements; special problems with American types.

Echelon of the R.A.F.

Central Press Photo

Repair and maintenance under handicap: With oil drums and planks substituting for jacks and workstands these British mechanics are making one whole Wellington bomber out of pieces of several "casualties."

OBSERVERS and technical personnel sent over by the United States to assist the Royal Air Force in the various theatres of war should have valuable information on war-time repair and maintenance for the United States Air Corps.

Britain has organized this work with great detail. Use is made of every part of a crashed plane. Over there they have learned much from experience and, of course, they have had the handling of American as well as British types.

The organization for the repair of the equipment of Royal Air Force units based in Britain is controlled technically from a directorate in the British Ministry of Aircraft Production. Executive action is controlled jointly by a Royal Air Force group in the Maintenance Command and a Civilian Repair Organization.

Royal Air Force Service Repair Depots and the Salvage Organization, with its many units geographically spaced throughout the country, are contained within the Royal Air Force Group.

Salvage Units are equipped with specialist transport which includes mobile workshops and cranes, light utility vans for the transport of personnel, trucks for equipment and the 60′ long girder trailers colloquially known as "Queen Mary's" on which complete fuselages and wings may be transported to appropriate repair centers.

CIVIL FIRMS ASSIST

A Civilian Repair Organization, which has been brought into being since the outbreak of war, coordinates the activities of the many civil firms whose services have been enlisted to deal with the vastly increased volume of repair work on airframes, airframe components and parts, instruments and other technical equipment.

This organization is also used to assist in maintenance when the volume of work arising due to periodic inspections, is beyond the the capacity of squadron and station technical personnel. The increased volume of repair work on engines, propellers, and other accessories, is being dealt with largely by daughter or fringe firms, who are associated with the main engine and propeller manufacturers.

Before the war, airplane maintenance undertaken by service personnel attached to squadrons and stations included a considerable amount of repair work, in addition to the routine "maintenance inspections," adjustments, replacements, and the like necessary to keep their aircraft in an airworthy condition. Since the war began, however, maintenance has become a more serious and specialized job. This has involved some reorganization in the duties undertaken by squadron and station technical personnel, and the majority of the repair work is now dealt with by the repair organization. Each station from which many squadrons may operate, however, has an engineer officer with a staff of mechanics and workshop equipment sufficient to cope with the maintenance of and minor

repairs to all the aircraft at that station, in other than very exceptional circumstances.

WHEN A SQUADRON MOVES

The method and technique employed is comparable in essentials with that used on commercial airlines before the war, but is amplified, and, of course, greatly speeded up to include the maintenance of purely operational equipment as well as the basic engine and airframe routines. Time between overhauls have also been extended owing to the necessity of keeping aircraft in the air for the greatest possible time, consistent with reliability.

The most recent organization used by fighter units for the maintenance of their aircraft is known as "Echelon," and it is designed to avoid the movement of all "material" above an absolute minimum when the squadron moves its personnel from one station to another. Thus during such a move, merely the personnel, certain specified equipment and transport are moved, and the actual aircraft with all its kit and maintenance personnel—which is termed the "Echelon"—remains at the station and continues to maintain the aircraft, although a new operating squadron may have taken over this aircraft. This essentially is a similar scheme to that used by the Germans, and has the advantage of continuous maintenance and the minimum of transport difficulties consequent upon any squadron movements. This organization is standard to all operational aerodromes whatever their geographical or strategic location.

INSPECTION ACCORDING TO TYPE

In the matter of periodic servicing and inspection, changes have been made, due to the stress of wartime conditions.

Before the war, a system of graduated maintenance operations and inspections was in force for performance after every 20 and 40 hours flying with major inspection normally at 120 hours. Now, however, minor inspections are made after every 30 hours flying with the major inspection normally at 240 hours.

Commands have latitude to increase the intervals between minor and major inspections, and to vary the inspections and operations in accordance with experience of the particular type with which they are concerned. The general principle, however, that maintenance must be organized in a series of graduated operations designed to ensure progressive repair and replacement is adhered to.

A definite life between complete overhauls is fixed for each type of engine, in the first place by the Ministry of Aircraft Production, but, after experience with the type, commands are empowered to vary this interval. A life between complete overhauls is not fixed nowadays for the airframe. As a result of a major inspection, the airframe is either certified as fit for a further period of flying, or is handed over to the repair organization for complete overhaul.

EQUIPMENT STANDARDIZED

The equipment used by the maintenance personnel is standardized at all Royal Air Force aerodromes, whether front line fighter and bomber stations, or merely reserve training or communication fields. Each fitter and rigger is issued with a standard kit of tools, and there is, in addition, a "flight kit" comprising more elaborate and special tools, also an "engine kit" which includes all tools and devices peculiar to the power unit of the particular aircraft to be serviced.

In the case of crashed aircraft, the damage done is summarized in a report and is then classified and placed in one of the specified "categories." These cover crashes which can be repaired in the field, those which must be transported to a repair center (or, perhaps flown to a repair center after a temporary repair on the site) and those which are beyond economical repair. Those beyond repair are returned to particular units in the repair organization where

An A. A. F. mechanic, wearing his tin hat, works in a dimly-lit hangar during the night, his engine illuminated only by a spotlight.

Keystone Press Photo

At an aerodrome "somewhere in England" British mechanics are working on the engine of a Tomahawk, R.A.F. version of one of the Curtiss-Wright P-40 fighters

British Combine Photo

Central Press Photo

Left. Another view of salvage operations on the Wellingtons. Details of the sturdy "geodetic" principle of construction as applied to the wing sections are plainly discernible in this shop view.

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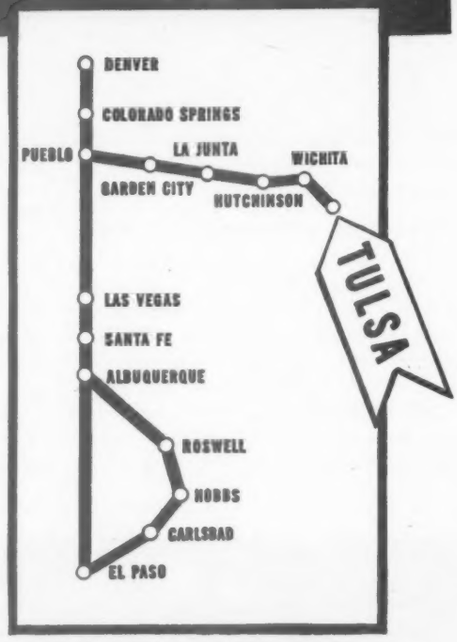
CONTINENTAL AIR LINES New Super Lodestar in flight. Continental now flies to Tulsa . . . *using Texaco Aircraft Engine Oil 100%.*



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FOR THE AVIATION INDUSTRY

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for War Needs.

Echelon of the R.A.F.

(*Continued from page 123*)

all components, parts and materials that can be used again are carefully saved, the remainder being reduced to produce. There is also a scheme by which operational aircraft damaged by enemy action but still airworthy, can be flown in to repair centers for quick repair.

WORK FOR THE SPECIALIST

Operational and training stations are, therefore, relieved of all responsibility for complete overhauls and major repairs to equipment. These are dealt with by the repair organization, the work is fed in to repair capacity, service and civilian, which is widely dispersed throughout Great Britain. Specialist work demanding great skill has to be catered for, and special equipment has to be set up at centers dealing with engines, propellers, armament and the many types of aircraft instruments.

For some types of equipment, Royal Air Force resources at Service Repair Depots afford the main capacity, and at the same time, facilities for practical training repair and maintenance.

Engine Repair Depots are sometimes operated by civilian firms under contract, these firms having been experienced in peacetime in engine production, repair, or some associated activity. The Civilian Repair Organization has also established many centers for aircraft repair and other work of a specialist nature by adapting factories and premises used for entirely different activities in peacetime.

The maintenance and repair of U. S. planes raised many difficulties in the early stages of their arrival in Britain. This was bound to arise, due to the haste with which orders had been placed, transfer orders accepted, and reception organized. Descriptive technical literature and information on accepted inspectional and maintenance routines for these types was difficult to obtain.

The installation arrangements on American types were designed mainly to meet peacetime requirements. Conduits, control runs, etc. were tidily built in, and were accessible for maintenance and inspection only by removal of various panels. British operational aircraft look untidy in comparison—conduits, control runs being draped, it almost seems, haphazardly around the ship—but that apparent untidiness is the result of long standing operational experience and spells accessibility, which means a saving of many hours when aircraft are grounded for maintenance attention. Thus, although U. S. aircraft are certainly no more complicated in essentials than are the British types, the impression of complication may be given by the number of inspection panels which have to be removed to get at parts of the aircraft. In peacetime, these parts might need examination only at comparatively long intervals, but during active service, they must be readily accessible at all times.

The training of British personnel in the servicing of U. S. aircraft is quite an easy job now that information and personal advice is available, and no more difficulties should be encountered. Apart from the excellent workmanship and design of U. S. airframes which are too well known to need praise here, the individual items which have received most praise and most criticism are, respectively, flying controls and engines.

Without exception, pilots are enthusiastic about the lightness and positiveness of the controls on American aircraft, large or small. The trouble with the engines is more difficult to analyze. In the earlier cases, boost control gave trouble; British pilots, experienced as they were to automatic control of boost with throttle opening, neglected to watch the boost pressure, and on occasions, took off with full boost at ground level—which did the motors no good at all. With American liquid-cooled engines, a lot of trouble was encountered in accessory drives which might be put down to the usual "teething" troubles of a type new to American manufacturers, but, of which the British have had long experience. American radial air-cooled types in commercial aircraft have, of course, proved themselves second to none, and any trouble they may have experienced in service in the Royal Air Force are probably due to the enforced necessity of maintaining full power over long periods—for obvious reasons. These troubles are, of course, not confined to American types.

MORE SPARES HANDY NOW

Another problem which is gradually being cleared up is that of adequate provision of American aircraft spares, which, during the early stages of deliveries, arrived in unbalanced and irregular batches.

At that time many perfectly good machines were grounded through lack of some component which had to be replaced owing to wear or to enemy action. In some cases, grounding was due to lack of special tool kits required for particular engines, and—again in the early stages due to lack of transport organization and other causes—there were instances of a "single tool kit" for the Allison engines of Tomahawks being passed from aircraft to aircraft, and sometimes even loaned by one station to another.

Without having detailed and up-to-date information on the maintenance methods of the U. S. Air Corps, it would be reasonable to assume that they operated as did the Royal Air Force in peacetime—on the basis of thoroughness rather than that of speed. The British plan may well be of assistance now that the organization faces up to the demands of active service.

America At War

(*Continued from page 110*)

done. They are well mixed already. The interests of all persons and companies are being dropped. That grand old institution, competition, is out the window. This is the world's first war of machinery; no such merger of manufacturing ever happened before. It will be worth living a few more years, even if you're all tuckered out, to see who makes what, out of what, and for what price and for whom—after the war.

Production of airplanes seems to be well in hand, and you can say as much for operations. The airlines finally got an umpire to stand by and see that they are not pulled apart in a dog fight over their possessions. The War Department is the great white father, and Brig.-Gen. Donald Connolly is his angel. If you were clairvoyant you could count a dozen moguls in Washington who would love to add the airlines planes, shops, mechanics and pilots to their war effort. But the Administration decided to keep the system intact. This was mostly due to the fact that the air system itself demonstrated, with tact and skill, that it could perform more valuable services as an entity than it could in parts.

Therefore, Gen. Connolly was appointed Military Director of Civil Aviation. His job is to administer traffic priorities on the lines, for the prosecution of the war, and to give the lines special missions to perform, under their own managements and the hands of their own pilots and servicemen. Chances appear to be ten to one that the system will come out of the war in one piece.

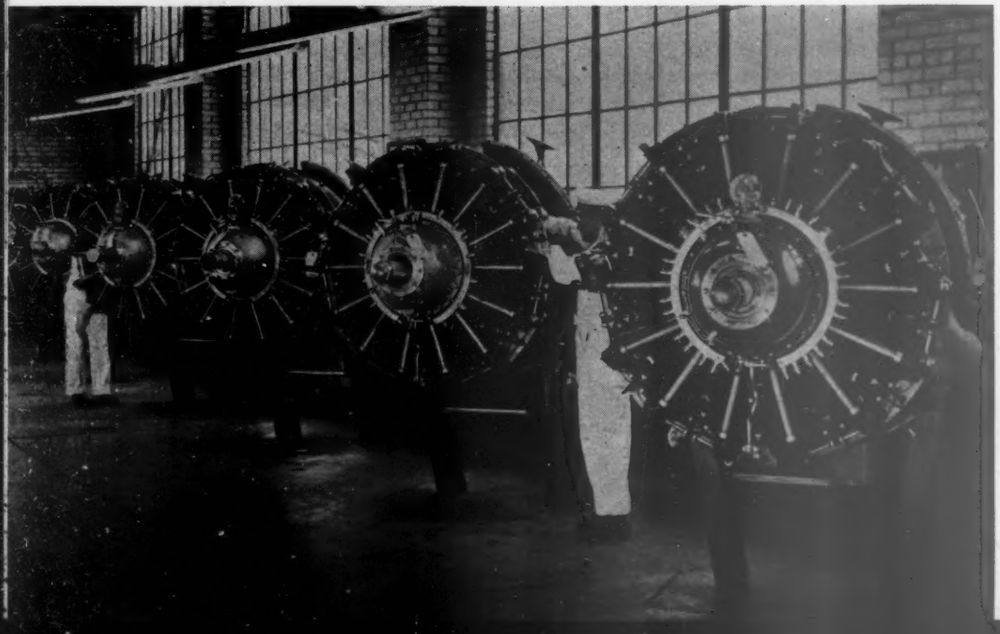
In the Services, two big expansion moves have been made. The Army Air Forces have again set their sights up—to some point far beyond the 84 combat groups which was their objective. The new objective is 2,000,000 men. It may be that this figure is being doubled. And the Navy is expanding its pilot training program by 30,000 cadets who will be put through four ground schools in as many American colleges. Both Army and Navy have ditched their requirements of two years of college. If the seat of your pants is sensitive to the lift of airfoil, you don't need a fraternity pin.

MAINTENANCE NOTEBOOK

Timely ideas from around the country for civilian and military maintenance men.

At LaGuardia Field, Pan American built triangular booms for engine changes. The chain hoist has not yet been attached as this picture was taken.

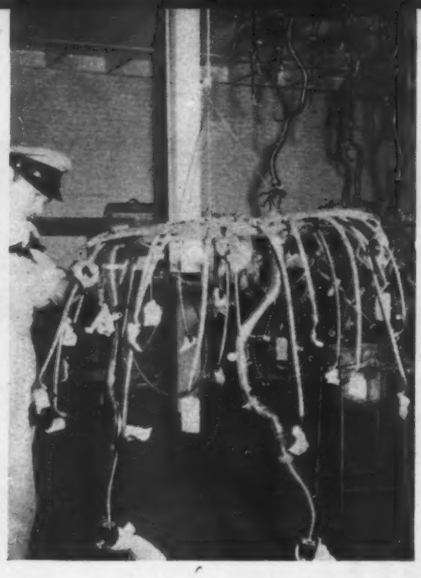
At Kelly Field engine changing has become a fine art. Every process has been analyzed and each crew member assigned to specific duties. Result: engine changes require about one-fourth the former time. This is a P & W Wasp Jr. being installed in a BC-1. Right.



At Brownsville PAA does engine overhaul for several divisions, handling many types of equipment. This shows the compact instrument board in the engine test house where all engines are run in.

Every repair base needs a place to store its engines that have been overhauled and that are ready for service. At Cheyenne, United Air Lines set these sturdy I-beam stands into concrete blocks. Engines are brought in on portable stands, picked up by an overhead chain hoist on a monorail, and finally bolted to these stands. All accessories are added and then cowls are fastened in place. These engines can be swung into place on a Mainliner with a minimum of trouble. Engines are P & W 1250 hp. Twin Wasps.

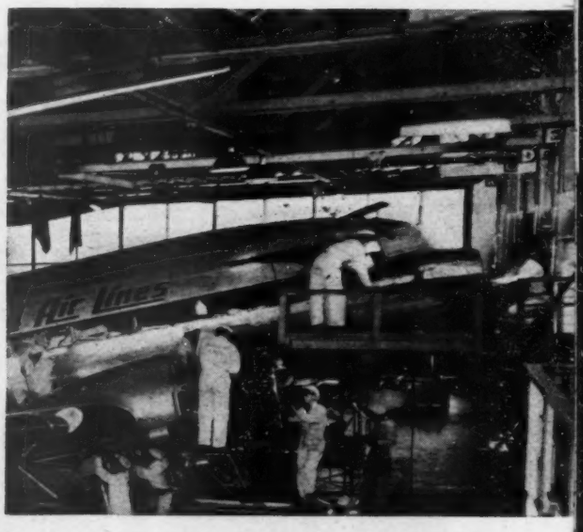
Mechanics at Randolph Field got tired of crawling around the floor inspecting the many low parts of basic trainers. They speeded up their work, as well as made it more comfortable, by using these rubber tired and padded racks. This photo was taken at night with a flash bulb.



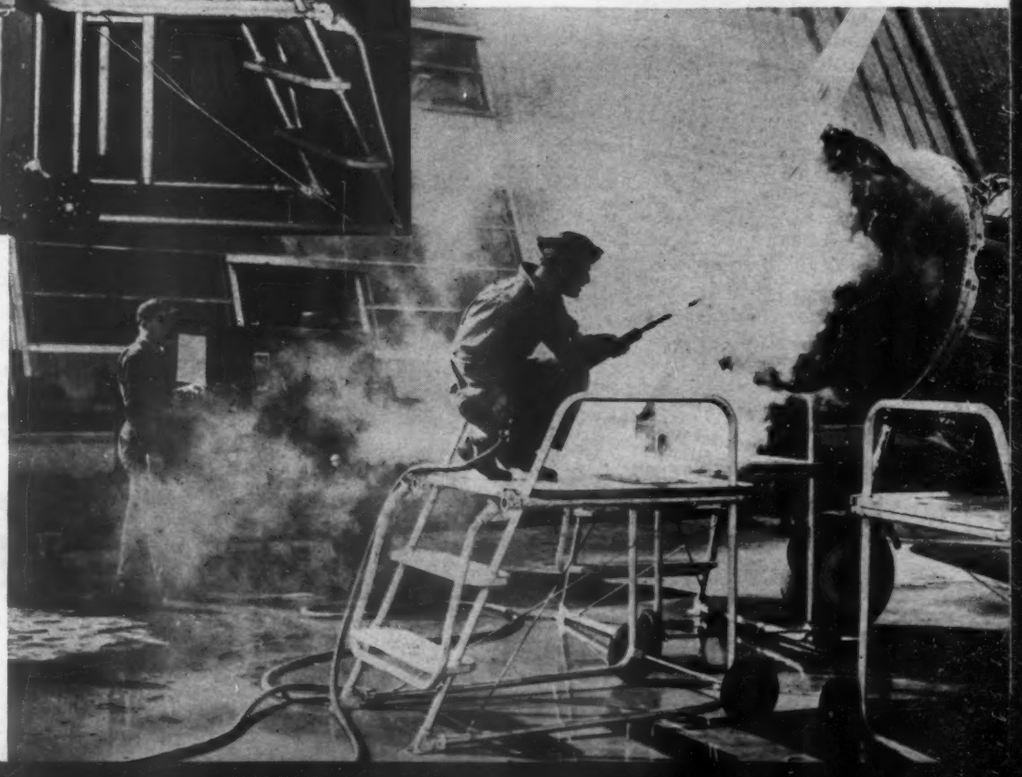
Since no one has devised an assembly bench for ignition harnesses, Pan American Airways merely hangs them from the ceiling at the busy Brownsville base. The mechanic can turn the harness. This base overhauls engines for Mexican, Central American, Pacific and Alaskan divisions.

Boeing School developed this trailer crane. It lifts one ton, hauls two tons. Front wheel has a brake.

Movable fluorescent lights are of great help to Randolph Field mechanics. An intense light can be directed exactly where it is most needed for night work.



United Airlines built wooden gangplanks that hinge at the wall for working around nose of transports.



Engine cleaning on a BT-13 at Moffett Field, Cal. This workstand is of practical design. Handle at left swings up, permitting stand to be moved easily. Yet when stand is in place the nonskid feet at left prevent it from jumping around. Oil burning unit for generating steam is in background.

A LITTLE TOOL THAT MAKES TOUGH JOBS EASY

Photos taken under actual working conditions — courtesy Northwest Airlines, Inc.

Sioux 1/4"

ALL ANGLE ELECTRIC DRILL

Its handiness and adaptability enables the operator to gain access to hitherto inaccessible places. A handy tool that is especially designed for "close corner" work. Length 7½", net weight 4¼ lbs. (Illustration about 85% of actual size.)

Other SIOUX aviation production and maintenance tools include: the Dual-Action Valve Seat Grinder; Valve Face Grinding Machine Wet Grinder; Electric Drills, all sizes; Phenol Abrasive Discs, etc.

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STANDARD THE WORLD OVER

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Preventive Maintenance To "keep 'em flying"...

With government and industry taking to the air to solve their transportation problems, airlines must make the best possible use of equipment available.

By J. F. MARTIN
Superintendent of Maintenance, American Airlines

American Airlines Photographs

AS WAR overtakes this nation and speed in defense becomes ever more essential, American industry is taking to the air to solve its transportation problems. This is a war of machines and production. Above all it calls for speed to out-blitz our enemies.

Government leaders recognize the vitally important part the airlines are playing in speeding the wheels of industry. However the even more urgent need for military aircraft has prevented more than a limited number of ships being delivered to commercial lines. It is up to them, therefore, to make the best use possible of equipment on hand. This means planning schedules to aid industry more than vacationers, and arranging overhaul procedures so that equipment is out of service for the shortest possible time consistent with good workmanship.

American Airlines, operating the largest fleet of transport planes, has taken the lead in gearing its operations to wartime needs. Extra shifts have been set up at the big overhaul base at LaGuardia Field in New York so that more schedules could be set up without adding to the present fleet of Flagships.

To help "keep 'em flying" without mechanical interruptions, a system of preventive maintenance has been set up to check up on every part of the planes in between overhaul periods. It has been determined from previous inspection reports how many hours of flying time each part should serve before being overhauled or replaced, allowing a sufficient margin of safety. For example, the 1,100 horsepower Cyclone engines must be pulled off and overhauled every 700 hours of flying time. Inspections and spark plug changes occur even more frequently.

It is the duty of the airplane routing office to keep track of each ship on the line and in overhaul. They must see that a ship is put on a route into New York whenever its time nears the limit permitted before maintenance work must be done. On the other hand they also aim to keep the ships in service for about 95 percent of the permitted time. This calls for pretty good scheduling work since the American Airlines system extends from coast to coast and some of the routes do not go to New York.

To meet the problem, the control office receives an individual report by radiogram from each base station giving the schedule routing of all airplanes in that sector, a list of the spare ships at the station, the individual engine times since overhaul, and the time, in hours of flight, since the last inspection of each airplane.

Inspections between engine changes are done at the base stations, so the routing office issues the necessary instructions. When American's expert mechanics have completed the job, the inspector has okayed it, and in the case of engine change, the ship has been flight tested, the routing office releases it to the flight operations office for use on passenger flights.

MAINTENANCE PROCEDURE

The procedure followed by the line maintenance department is as follows: the daily or line inspection is made at an intermediate station if an airplane is to lay over for ten hours or more; the base inspection is made at a base station if a ship has been in service and will be out of commission for ten hours or more; and a major inspection which is made at a base station before every 150 hours of flying time.

While mechanics are busy on the engines, ailerons and landing gear, the fleet service section is on the job cleaning the ship inside and out. The buffet and lavatory are washed, rugs and upholstery are vacuum cleaned, new magazines are supplied, and in the Flagship Skysleepers berths are prepared with fresh linen.

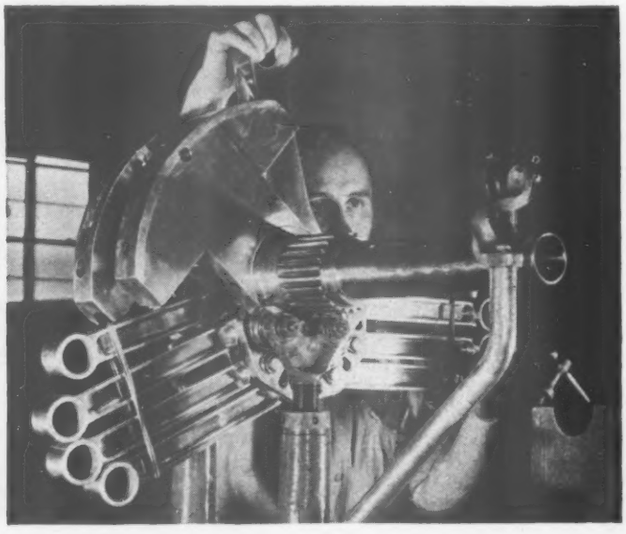
The regularity of operation nowadays permits maintenance schedules to be set up some time in advance. A continuous log record is kept of every mechanical part of each ship and when a part nears the maximum flight time permitted before overhaul, the department concerned is notified and they can plan their work more efficiently. Notices are usually issued two weeks or more in advance so that each section of the overhaul department will know how many jobs to expect each week.

What keeps the routing office on its toes are extra sections, charter flights and special test flights made by the engineering department for purposes of

1. Clerks in the airplane routing office of American Airlines keep strings on every Flagship in the fleet at all times. When a plane is due in the overhaul shops for periodic work, they pull the string and there it is.

2. Periodically each engine is sent through the engine overhaul shop. It is completely torn down, every minute part is examined, and replaced if it shows wear. Here, an inspector checks a piston pin.

3. All component parts of a Flagship engine are subjected the Magnaflux test. In this, a solution containing fine iron particles is passed over the surfaces after the item has been magnetized. Should a crack or flaw be present, iron particles are attracted to form a clearly visible line.



4. A mechanic in the engine overhaul shop of American Airlines at LaGuardia Field checks the alignment of a crankshaft before it is assembled in the engine. Precision is of paramount importance and here the mechanic holds down the alignment to the required one six-thousandth of an inch.

research. A reserve ship is kept for extra sections at all times, and on Friday and Sunday and just before holidays they must plan to have all possible ships in service.

OVERHAUL SYSTEM

Set up as a separate department from line maintenance, is the airplane overhaul section of the general maintenance department. Activities here are classified in four operations, each requiring the Flagship to be in the shops at LaGuardia Field for a specified period of time.

"Operation 1" entails the change of both power plants, a major inspection of the plane as performed by the line maintenance department, the periodic accessory changes that are due on airplane parts—landing gear shock struts, oil tanks, landing gear retract struts, hydraulic pressure accumulators—and a general repairing of the interior.

The operation is carried out approximately every 90 days, and is completed in about 24 hours.

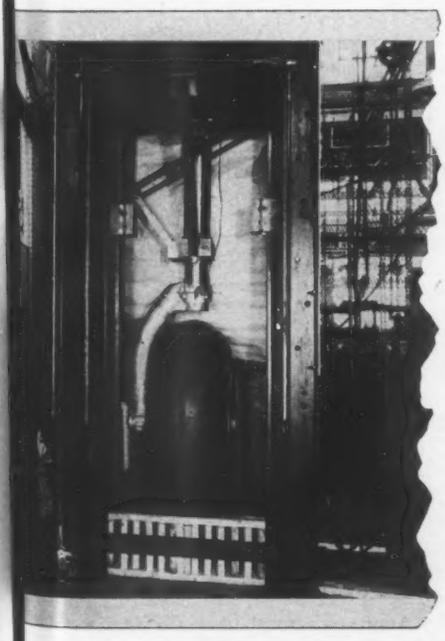
Executed on each plane approximately every 15 months, or each 3,000 hours of flying time, "Operation 2" consists of a general shakedown inspection and overhaul of all major component parts of the airplane. This work requires about three days in the overhaul shop, and includes the removal

(*Turn to page 202*)

GIVING AIR HORSEPOWER ITS *LAND LEGS*

● Brewster Buccaneer
Long Range Dive Bomber

Ohio Seamless Tubing
Gives Landing Struts Strength to Take Toughest Shocks



Another key job well done, the husky dive bomber glides swiftly to the field. Controlled by competent young hands it skims neatly over the ground and slows to a smooth, precisioned stop. Another safe landing . . . another fine ship ready for more successes.

The moment of contact between bomber and runway is a crucial one. Fast, almost irresistible force meets immovable surface . . . the impact must be cushioned, the crushing shock absorbed. The aviation engineer knows the super-strength and flawless construction that a shock strut needs to take its punishment safely.

In the hydraulic and pneudralic shock-absorber struts used on modern fighting planes, you'll find Ohio Seamless Tubing. Providing extreme tensile strength (up to 200,000 p.s.i. when properly heat treated) Ohio Aircraft Tubing more than satisfies the requirements for a light weight section that takes high unit stresses without distortion, buckling or weakening. Ohio's processing and annealing in continuous controlled furnaces keeps both inside and outside surfaces free from scale, pitting, seams, other minor defects — to meet rigid Army and Navy specifications. Remarkable uniformity in all qualities — strength, wall thickness, size, ovality, hardness, machinability — equips Ohio Tubing to meet the exacting tolerances in aircraft work.

Ohio Quality Seamless Tubing is used in many different aircraft parts. And it is produced in various grades of steel and alloys, in gauges, finishes and lengths for thousands of industrial uses where, as in aircraft, the weight-strength ratio is all-important.

◀ TEN THOUSAND POUNDS of lead shot in a weight box above a test strut . . . released in a sheer drop. Impact! And another shock strut based on Ohio Seamless Tubing proves it can take it.

THE OHIO SEAMLESS TUBE COMPANY

SHELBY, OHIO

OHIO SPECIAL QUALITY

Commercial Flying in Alaska

(*Continued from page* 59)

these small companies keep on the go.

They carry passengers, ranging from the Governor of Alaska to a poor Indian boy with a broken leg, and freight from a small loaf of bread to bulky mining equipment so heavy that it takes the derrick of a wrecking car to lift it in the plane.

Strange cargo often finds its way in the spacious bellies of the small ships. Chickens, cows and reindeer have been among the passengers, and as one of the younger Alaskan pilots remarked, "So far in four years of flying I have carried everything from ice cream to marriage proposals." Single-engined planes, mostly Fairchilds, Bellancas and Stinsons, with an average seating capacity of between four and eight, assuring operation with a profit, able to land and take off anywhere, are favored for Alaskan conditions.

Alaska proudly lists aviation as a major industry and of the 120 landing fields in the Territory over 100 have been built with Territorial funds. Natives point out that they have the largest number of airports per capita of any country in the world.

THE INDUSTRY

Center of the aviation industry in Alaska is the mining town of Fairbanks, which thanks to the airplane, has a trading area larger than any other town under the American flag. Northern terminal of the Alaska Railroad and the Richardson Highway, it is the transshipping point for all the freight to the rugged interior, from Canadian border to the shores of the Arctic ocean and the Seward Peninsula.

When in late spring trains and trucks pour an avalanche of assorted goods, from shovels to dredge parts, into Fairbanks, airplanes manage to distribute the freight as it arrives, for there are around 50 planes making their home port at the little mining town of less than 5,000 inhabitants. From there they make frequent calls at some 90 air fields, not including the number of open spaces which serve as landing fields, and the hundreds of small lakes.

Prospectors, miners, and trappers who have their eye on a region hundreds of miles from civilization, made inaccessible by mountains and wilderness, charter an airplane and in a few hours a pilot has them and their supplies landed at a clear spot in the country they intend to work during the season.

On the appointed day, at the end of the season, the pilot returns and picks up his customers. During the summer, pilots who know the location of the camps keep their eyes open when they fly overhead and a circle of brushes and branches on the ground will bring the plane swooping down to inquire what the camp wants.

FLAG STOPS

Airplane companies in the interior service hundreds of such flag stops and pilots who specialize in catering to them are called brush flyers. In the interior the flying is done mostly on wheels in the summer and skiis in the winter. Pontoons are often used near the seashore, lakes and larger rivers. In Southeastern Alaska, where snow-capped mountains 3,000 feet high rise straight from the seashore, and glaciers cover the valleys, all the flying is done on floats.

At Juneau, where planes form the connecting links between the main center of population and the settlements on the outlying island, the pilots have to cope with some of the worst year-round flying weather on the American continent. In Southeastern Alaska annual rainfall is over 120 inches.

Typical of a small Alaskan air transport company is the newly organized Alaska Airways in Ketchikan. With four planes operating out of Ketchikan it works a regular flying schedule to several small towns, but it also will fly anywhere in Alaska.

Until recently there were two companies in Ketchikan, the Ellis Airways, headed by Bob Ellis, and the Aircraft Charter Service, operated by Herb Munter, veteran Alaska flyer, but the National Defense Program called pilot Ellis into the Navy so the two companies merged to give better service.

A small company like the Alaska Airways employs eleven persons, consisting of three pilots, four mechanics, three agents, and the all-important traffic manager who keeps the books, arranges the schedule, rounds up the passengers just before the departure time, gets the mail aboard and looks after the freight. All the planes are equipped with two-way radio sets and all the members of the staff are licensed radio operators. Up to the first of the year Ellis Airways, competing directly against Herb Munter, flew 12,221 passengers and 1,281,000 passenger miles in eleven years of operation, using two planes.

The subject of aviation in Alaska would hardly be complete without mentioning the men who fly the ships in the Northland. Until recently, there were no radio range stations, and the pilots fly largely by dead reckoning and their knowledge of the country. Veteran of the Alaska flyers is Herb Munter, who started to fly in 1912 and who wears the insignia of an Early Bird.

Mercy flights to bring in men for medical attention, flights to drop food to a starving settlement might be hazardous, but they are routine duty for northern flyers. Probably one of the most spectacular feats of flying ever done to save human life was accomplished by Bob Ellis. A man was dying from pneumonia in the Ketchikan hospital and oxygen was the only hope for him.

Off the Coast, lying somewhere at anchor in a protected inlet was a U. S. cruiser. Contacted by radio, the cruiser reported it had oxygen aboard but was unable to proceed to Ketchikan due to fog and bad weather. It was late at night. Ellis figured the boat's position, took off, and landed by sheer dead reckoning near the ship, got the oxygen and returned to Ketchikan.

Joe Crosson, General Manager of the Pacific Alaska Airways, is one of America's foremost authorities on flying under Arctic conditions. There are a score more with names well known beyond the boundaries of Alaska who prefer flying in the Territory because they love the wilderness and in their blood is the spirit of pioneering.

ARMY AND NAVY

Since the start of the National Defense program Alaskan aviation has been given a big boost. Uncle Sam is building large army and navy bases, spending close to a $100,000,000. Already the army has experiments in cold weather flying going on at its newly built experimental station at Ladd Field in Fairbanks.

There is no doubt that commercial aviation will benefit from the results. Already aids to aviation are being built all over the Territory and C.A.A. is constructing a number of radio range and communications stations in Alaska.

The Territory of Alaska is destined to play a great role in the aviation of the world in the near future, for across the barren tundra and wilderness passes the route for airplanes between United States, Europe and Asia. Many aeronautical engineers consider Fairbanks the geometrical center of the aviation world. It is the logical stopover point for intercontinental flights by landplane. The small planes and the daring pilots that today roam the Arctic skyways may soon see processions of warplanes and, later, huge commercial airliners following the routes they pioneered in Alaska.

On Target!

Brewster Buccaneers—Modern Sea Raiders

The Dive Bomber was pioneered by the United States Navy. Its wide range serves to increase greatly the accurate and deadly striking power of our Naval Forces.

The Brewster SB2A-1, with Curtiss Electric Propeller, known in America as the Buccaneer, in Britain as the Bermuda, can be counted upon "to give it back with compound interest".

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CURTISS-WRIGHT CORPORATION, CALDWELL, NEW JERSEY

LET'S GO! U.S.A. KEEP 'EM FLYING!

CURTISS *Electric*
PROPELLERS

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Radio Ignition and Auxiliary Shielding • Multiple Circuit Electrical Connectors • Flexible Shielding Conduit and Fittings • Conduit Junction Boxes.

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Breeze has set its course for the one goal toward which all America is striving — the goal of complete Victory. To this end Breeze has dedicated all its plants, is turning out ever-increasing quantities of vitally needed equipment for the U. S. Army, Navy, and Air Forces. The well-known line of Breeze products for defense includes Breeze Electrical Connectors, Flexible Shielding Conduit and Fittings, engineered to strict A-N standards, Aircraft Armor Plate, Aircraft Tab Controls and Cartridge Engine Starters. These as well as the many other items of Breeze equipment, are serving dependably today with America's armed forces on land, on the sea, and in the air.

Breeze CORPORATIONS INC.

NEWARK, NEW JERSEY

By CRAIG WALSH

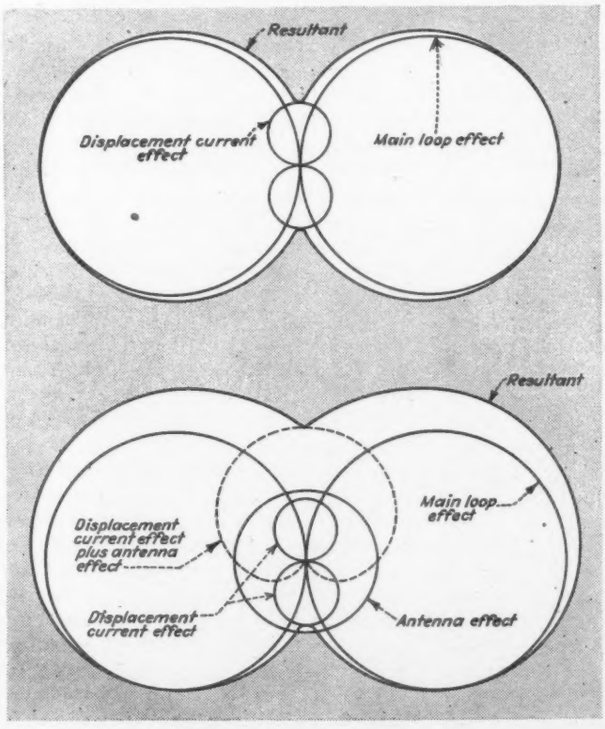
RADIO

George Levy of United Air Lines Addresses Radio Engineers

George F. Levy, of the radio laboratory of United Air Lines, addressed the 30th annual convention of the Institute of Radio Engineers at the Hotel Commodore in New York on January 12. His subject was "Design Problems of Directional Loop Antennas for Aircraft." Such antennas are very useful for aircraft operation because they are highly efficient, small in size, directional in response, and can be electrostatically shielded to eliminate precipitation static. They are generally mounted outside the fuselage of an airplane and therefore produce considerable drag. It was estimated that a loop contained in a tubular metal shield 1½ inch thick and 12 inches in diameter, and mounted in the conventional manner, requires a power of 7 horsepower to carry it at 180 miles per hour. If the same antenna becomes coveerd with ice so that its open center is a mass of solid ice, and its broad surface to the front, it will require 25 horsepower.

The low impedance loop which consists of about six turns of wire enclosed in an electrostatic shield is commonly used. Also widely used, especially in automatic direction finders, is the high impedance loop consisting of from 7 to 20 turns enclosed in a streamlined housing. In this case the position of the housing is fixed and the loop rotates within it. One of the serious problems confronting the loop antenna designer is keeping moisture out of the loop. When moisture does get in, the Q of the loop goes to zero with very bad results. The rapid changing of altitude of an airplane aggravates the problem because as it descends the pressure within the loop structure becomes lower relative to the outside pressure, and air or any moisture on the outside surface of the loop will be sucked inside. Therefore all loop structures must be hermetically sealed to avoid this trouble.

Mr. Levy also discussed the several characteristics of loop antennas which impaired the directional pattern. Among these characteristics are the displacement current effect of a solenoid loop, winding pitch effect in a pancake loop, and the antenna effect present in both types. The antenna effect can be greatly reduced by electrostatically shielding the loop. By using both a solenoid loop and a pancake loop, and connecting them in series, the other two effects can be eliminated.



Diagrams showing how the directional characteristics of a loop antenna are affected by the displacement current effect due to the physical separation of the individual turns, and the antenna affect which is non-directional.

Radio Compasses Discussed by Wilbur L. Webb and Gerald O. Essex

"The Automatic Radio Compass" was the subject of a paper delivered by Wilbur L. Webb and Gerald O. Essex, both of the Bendix Radio Division of Bendix Aviation Corp. at the tenth annual meeting of the Institute of the Aeronautical sciences held in New York City, January 28-30, 1942. The speakers developed the subject systematically from a simple loop antenna attached to a suitable radio receiver using earphones up to the dual automatic radio compass which gives directional indications by means of signals from two different radio stations simultaneously, and the combination of an automatic radio compass with a stabilized remote indicating magnetic compass.

The combination of loop antenna and conventional radio receiver gives an indication which is ambiguous, that is, the signal may originate either in a forward or rearward direction. This ambiguity can be eliminated by combining the signal voltage obtained from a small non-directional or "sense" antenna with that from the directional loop antenna. The resultant directional pattern is a cardioid. The sense antenna is connected after the null point is located and the direction, that is, forward or back, can be determined by rotating the loop and noting whether the signal increases or decreases.

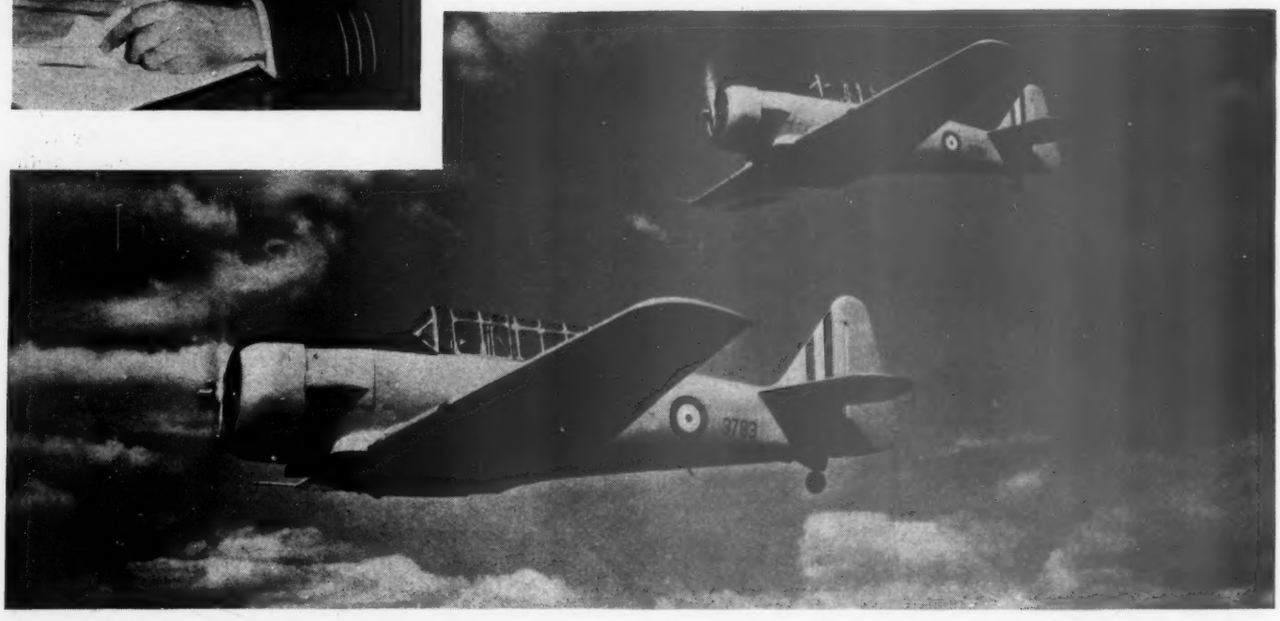
The next improvement was to provide a visual indication of the direction to a radio transmitter. This involves a continuous switching operation for the sense antenna at a predetermined rate by suitable electrical circuit.

Next the loop antenna was automatically rotated to relieve the pilot of this operation. The loop automatically seeks the correct position and thus gives the pilot an immediate bearing on indication on a remote azimuth indicator. No adjustments other than tuning in the proper radio signal need be made by the pilot. This affected a considerable saving in time in establishing a positive fix by radio bearings.

The automatic radio compass is a null seeking device. It is arranged so that

(*Turn to page 201*)

SALVAGING Aircrew Trainees



North American Harvard trainers used in the advanced pilot training course in the R.C.A.F. (Insert Above). Wing Commander H. J. Burden is officer commanding the Composite Training School at the R.C.A.F. base, Trenton, Ontario.

SALVAGING unsuccessful aircrew trainees has become a big job in the Royal Canadian Air Force. Because almost every young fellow who joins the R.C.A.F. wants to be a fighting pilot —and everyone can't make the grade— the R.C.A.F., as operators of the British Empire Joint Air Training Plan, were faced early in 1941 with the growing problem of what to do with the trainees who were "washed out," to use the trainees' own term, as pilots, observers, wireless air gunners and air gunners. It has been the policy in most military air forces to either discharge such unsuccessful aircrew men or find some ground post for them. The R.C.A.F. felt that to lift the morale of these chaps, to find a place in the aircrew for them, and to save the money already spent on teaching them as far as they had gone, something better could be done for these officially termed ceased and interrupted trainees. So successful has been the experimental plan since its inception in May 1941, that roughly 90 percent of those whose training was "interrupted" were retained in the air force, with 70 percent remaining as aircrew material.

A number of the white painted buildings at Trenton, Ontario, where is located the Dominion's largest air force station, are occupied by the K.T.S., the Composite Training School, initialed with a K because here is also located the Central Flying School. To K.T.S., after two weeks leave, are remustered the boys who fail somewhere on the road to becoming pilots, observers, gunners or wireless-gunners. They come from all the training schools operated by the R.C.A.F. in Canada, as well as those operated by the Royal Air Force in Canada and the United States. Boys from all parts of the Empire and the United States are shipped to K.T.S. for a series of examinations, interviews and instructions, which puts most of them back in some job where they can help directly in the air war against the Axis nations.

The morning following their arrival at Trenton, the ceased and interrupted trainees are paraded in a body before a senior officer of the Aircrew Squadron, K.T.S. There is a group nearly every day, and though figures on the number going through K.T.S. are necessarily a military secret, this is no hand-picked experiment, but an all-embracing operation covering all air training schools. This one parade is the only time when the men appear as a group. Thereafter they are treated individually. But the group meeting is to explain why they are at K.T.S., what K.T.S. hopes to do for them, and to allay any fears they may have developed as to the reasons for their being sent to Trenton.

Following this parade the men appear before a staff of medical officers, where they are individually examined for physical fitness, their records gone over, and a report made out as to their present physical condition. Should the medical examiner feel that physical fitness alone was not a factor in the remustering, the men are further examined and interviewed by specialists including psychiatrists and nerve specialists.

Then come personal interviews by a staff of nine interviewing officers, picked

To make use of the many good men who for one reason or another have been eliminated as aircrew trainees, Canada has established the Composite Training School. There, unsuccessful aircrewmen are given opportunities to train for other airforce jobs.

BY JAMES MONTAGNES

The Reselection Board, Aircrew Squadron, interviewing an air crew member for reclassification and remustering. At left is Squadron Leader Denton Massey, president of the board. (Above) A representative group of trainees, Aircrew Squadron. These men (l. to r.) come from Canada, U. S., Rhodesia, New Zealand, Great Britain, Australia, and Newfoundland.

for this job because of their civilian training as teachers, personnel specialists, vocational guidance specialists and other work which brought them in contact with large numbers of men. These interviews are to discover reasons for the failure of the trainee in his work, to find if a square peg has been fitted in a round hole, to give the trainee a chance to get his grievances off his chest, to discover what he would like do to in the service. Sometimes these interviews may take a few minutes, at other times they may last more than an hour. The interviewing officers want to find out all the contributing factors. Some cases require a number of interviews by different officers, and the most difficult cases are discussed in a frank man-to-man interview with the senior officers of the school.

Based, on the interviews, the men are allotted work while they are at Trenton. Some men may require some special coaching in courses on which they fell down, other may be found unfit for further aircrew work and are sent to the educational or trades school officers to see what other jobs in the service they could fit in, or what other jobs may appeal to them.

When all the data on the men has been obtained, a reselection board of three officers including a medical officer, sits in review of the case. No decision as to the case is made at this sitting. Then the man under review is called in, sits across the desk from the board, is put at ease, and his case is reviewed once more. He is asked his preferences, his views. The board makes its decisions based on the records and the personal interviews in his presence.

If the man is grounded, he can elect his trade. Wherever possible he goes back to aircrew training. He is started on the work he is to do in his new classification until he can be posted to a station. And if he still does not make good he can be remustered again and come before the reselection board a second time. But so well has the work of the board been done so far, that only a very small percentage of those who have appeared at K.T.S. come a second time. With few exceptions the men leave K.T.S. fully satisfied, determined to make good in their new classification.

It's not all smooth sailing for the staff at K.T.S. Aircrew Squadron. Since 75 percent of the trainees who come to the school were fledgling pilots, many of them come with a chip on their shoulder, come with the feeling that somewhere they had a raw deal. To get these cases to break down is a job requiring tact, perseverance and inspiration. The success to date of K.T.S. is largely due to the fact that the staff has those qualities, that they are specialists in measuring their men.

There are many reasons given for the failure of would-be pilots to make the grade. From the records at K.T.S., by far the primary reason is inability to bring a plane to a safe landing. With all the tests and exercises given and devised by specialists of all types, no surefire method of teaching oblique distance calculation has as yet been devised. And so, when students begin to take planes out, though their classroom work is excellent, they frequently fail to make

(*Turn to page 197*)

Light Planes At War

Ruggedness, ease of maintenance and ability to land in a hay field, win an Army observation assignment for the light plane.

By
WILLIAM STROHMEIER,
Piper Aircraft Corporation

TO ONE who has had three months experience flying light airplanes under simulated war conditions, the accounts of desert warfare in Africa seem to indicate that light, short range, slow flying liaison aircraft would be of inestimable value in conducting such military operations. News reports of the opposing Armies operating in confusion all over the desert should enable anyone to realize the dilemma in which a tank commander finds himself when he tries to determine the exact battle situation and what the next move should be with only ground reconnaisance to rely on.

In the rough rolling desert, it is entirely conceivable that two opposing forces can suddenly come upon each other over the brow of a dune with no warning of any sort. Under situations such as this, radio channels are likely to be so jumbled up, as to be ineffective and unreliable. Swift courier and message service available immediately, plus readily accessible planes for short reconnaisance, are vital to this new type of warfare which is much more like naval action than land fighting as it used to be known.

Similar situations of uncertainty and poorly defined disposition of opposing troops were found in the U. S. Army's desert maneuvers held this summer in the New Mexico area. I had the opportunity of participating in these maneuvers as a civilian pilot assigned to demonstrate the practicability of light airplanes for operations of this type. During some of the battle problems there was often a very indefinite grouping of enemy and friendly units. Flying over the battle with umpires, we could see a force of blue cavalry here, a red force there, and more blues on the other side of them. Without a clear picture from the air of the situation as a whole, a regimental or divisional commander would have little conception of how the battle is going or just where and how he should strike next. I found that an experienced Army officer had only to go aloft over his own territory, and watch the various dust clouds to see the general direction in which units were moving and get a clear idea of what was going on for miles around without so much as getting near enemy gun fire.

Grasshopper planes can operate independently of ground facilities, even to the extent of providing temporary shelter for crew's sleeping quarters, as demonstrated during the Army maneuvers in Louisiana.

Roads make the best landing ground for light ships. Narrow wing spans permit them to use roads closely bordered by trees, or other obstructions.

Of course some will say "Aerial observation of this sort is not new. Since the last war, armies have had aerial observation to aid them in their movements." This is true, but the observation available in the past to Army commanders is as old fashioned as muzzle loading artillery. The difficulty of coordinating observation, which operates from a field miles behind the scene of

"INTO THE SUN" by John Hammer

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action, makes such observation slow and uncertain under present conditions. True, long range observation with fast airplanes has a definite place in any warfare but an officer of a front line unit has his own immediate local problem which calls for his knowing the situation as quickly as possible.

To try to get a request through to the nearest observation air field for a plane to come out and report the situation ahead for the commander takes time. Even when such a request is received, the pilot and observer, not knowing exactly the commander's particular need for certain specific information, may often fail to report situations which are of vital importance to the men on the firing line.

The need, therefore, has arisen for a type of airplane which can be immediately available for just such work. Such an airplane must, of necessity, be able to land in small unprepared areas such as roads, hay lots, hill sides—any place near enough to the Command Post so that the observer and pilot may personally discuss the problem with ground officers and learn specifically what type of information is needed. Various types of airplanes have been considered for this work—helicopters, autogiros, as well as specially built orthodox airplanes of high power and light wing loading to enable short field operations. But all these types are either still in the experimental stage or cost excessive amounts. Furthermore they are not available in quantities to meet present needs.

Significant advantage of the light plane in military operation is their lightness, which enables pilots to move ships under protecting covering single-handedly. Larger ships require as many as six men to move.

Here an 0-59, working with the armored forces in the Carolina maneuvers of last summer, awaits orders in a small hay lot. Note the improvised gassing and service facilities at the right. Light planes can operate on any type of truck gasoline.

The light plane, born in poverty, developed to meet the critical, skeptical, demanding specifications of the commercial airport and flying school operator was at last given a chance to prove its value during the summer's maneuvers. The fact that the Army has ordered the Piper 0-59, Aeronca 0-58, and the Taylorcraft 0-57 in quantity tells sufficiently the story of how these airplanes successfully met the requirements for this type of flying.

The ten years spent in developing these planes showed effectively during the maneuvers in the form of exceptional ruggedness and their ability to take a terrific beating. It must be remembered that one of the main engineering problems of the light plane designers has been that of continual improvement of the airplanes from a maintenance standpoint. Not only was the practicability of the light airplane proven but its ease of servicing was demonstrated. One is as important as the other. Under these conditions planes must operate away from elaborate repair facilities, must be rugged, must be the height of simplicity throughout. They must live off the land, so to speak, when it comes to repairs and maintenance.

True, the light airplanes had their share of mishaps during the maneuvers, which can only be expected when the type of flying is considered. But it is interesting to note that, during five months of intensive maneuver operations light airplanes, when damaged, were, with two exceptions, repaired on the spot and flown away while the larger type of slow flying liaison aircraft, in every case, had to be trucked out when a landing gear was broken or other damage occurred.

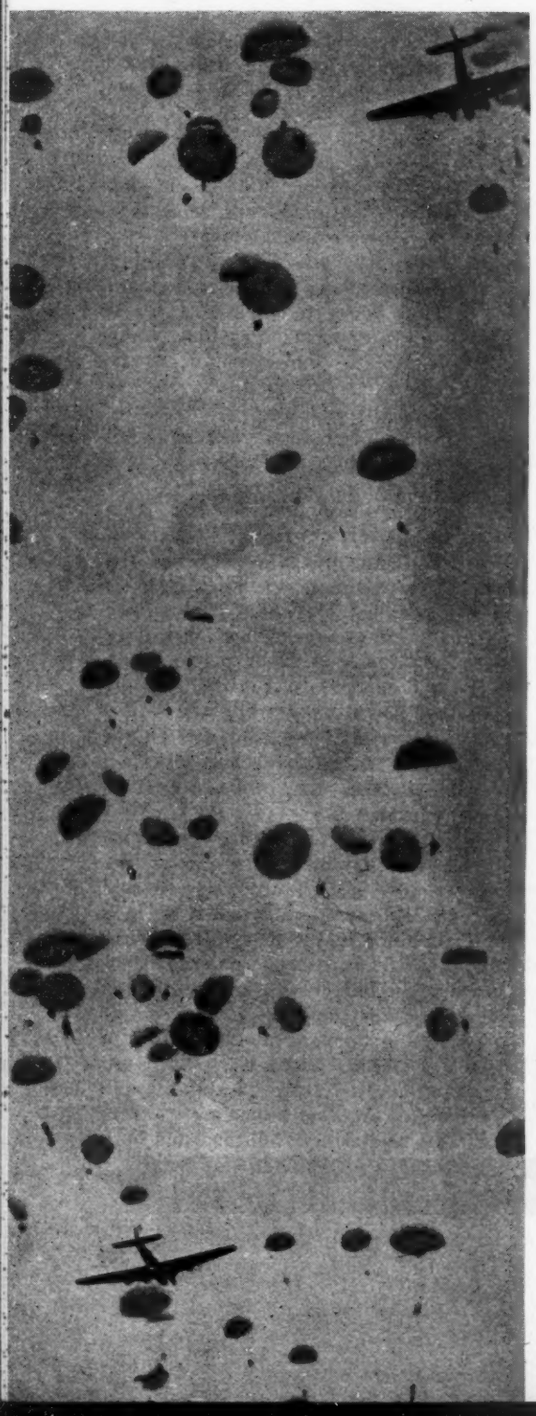
Some of the maintenance operations of the Grasshopper Squadron, as the light planes are known, demonstrated the excellent manner in which these may be maintained in the field. It is reminiscent in many ways of the old barnstorming repair-it-with-haywire days. Here are some examples:

One grasshopper pilot operated a whole day with a flat tire, being too busy to have it repaired by local Army mechanics. Another pilot took off from a 500-ft. field with a full load and both tires flat.

(*Turn to page 184*)

They Learned About Parachuting from Us

Russia got her idea of parachute troops from an American county fair—and passed it on to Germany



Wide World

Most of us smiled tolerantly at the parachute antics of the Russians, when in 1935 and 1936 they inaugurated mass jumps as shown here (left).

THE story of how Soviet Russia first got the idea for parachute troops has not been told. Some observers have expressed surprise that this advanced military technique should first have been developed in an industrially backward nation. Why was it that with the exception of the German army, no other Western power appears to have appreciated the significance of this development until the success of Hitler's parachute troops showed how effective this new weapon could be?

Actually the early development of the parachute troop idea in Russia was a byproduct of quite another purpose—the awakening of interest on the part of the youth in the Soviet Air Force. And it was activity in the United States that first planted the germ of the parachute troop idea in the mind of a Soviet military pilot. That man was my friend and colleague Sergei Mienov.

Although the Russians made good use of parachutes during the first World War, they had failed, in the midst of other problems, to develop this technique. Russian pilots were not well trained in parachute use and the manufacture of the 'chutes themselves had not progressed beyond the World War stage. There had been a number of serious accidents in our Air Force; the death rate among students, pilots and observers was higher in Russia than in other countries. Jakob Alksnis, the Chief of the Soviet Air Force, decided to send an observer to the United States to survey the work that Americans had done in the field of parachutes He selected Serge Mienov, a young, energetic captain in the Air Force.

Mienov stopped off in Paris on the way to the United States. We spent a few hours together. He was a little dubious as to how he would be received in America. How much would he be permitted to see? And even if the Americans would be cordial, was there much he could learn?

"Still," he said, "if there's anything new in parachuting, the Americans will have it."

He spent almost a year in the United States. On his way back to Russia he passed a few days in Paris. He was full of enthusiasm for what he had seen in the development of air technique. Although Russia was not yet officially recognized, Mienov had been courteously received. He had visited airplane factories, airdomes and training schools. He praised highly the quality of American parachutes and the instruction American pilots received in their use. He had made his first parachute jump here.

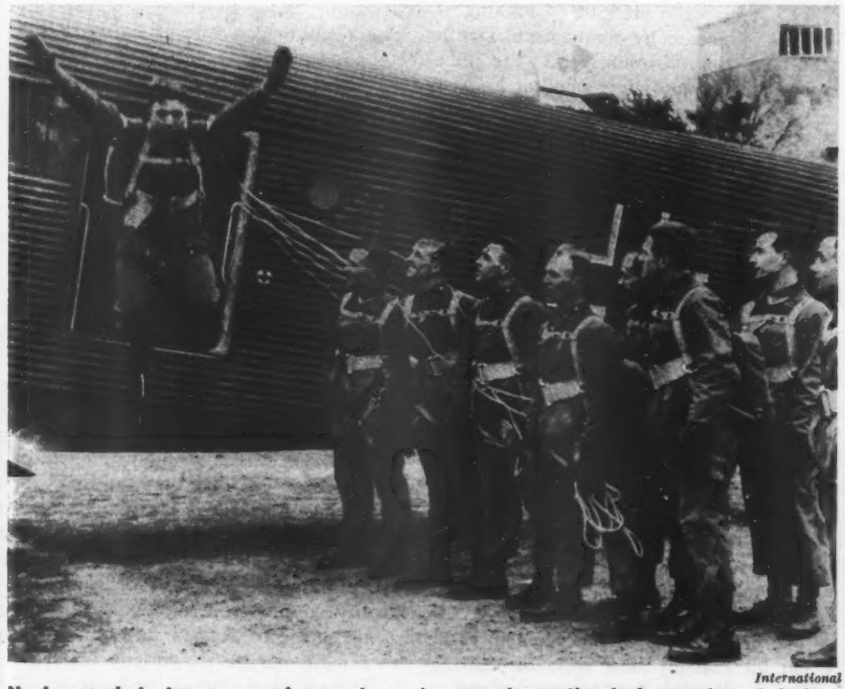
"But you know," he said, as we were seated in a Paris cafe, "I saw some things which were not so good. In order to make a living some Americans have to resort to pretty ingenious methods. Imagine, at a county fair I saw a man making parachute jumps for the amusement of the crowd. Here you have an object almost clinical in its purpose and it is used to give onlookers a thrill! Well, that is capitalist America; happily, in Russia where human energy is distributed by plan, a skilled airman does not have to make his living stunting at a county fair."

We were ready to go on to other topics of conversation, but Mienov stuck to the point, as if something puzzled him. "And yet," he said, "you should have seen the interest of the crowd. Such general excitement must have some value. It's worth thinking about."

When Mienov submitted the report

European

German military men were quick to see the value of parachute troops and improved on the Russian system. These are Nazi soldiers making practice jumps.



International

Nazi parachute troops spend many hours in ground practice before going aloft for their first jumps. Ropes are used to open parachutes in this practice.

By
ALEXANDER BARMINE

The author, now in this country, is a former Senior Officer of the Soviet Army reserve, a distinguished diplomat and government official. This is an excerpt from his recent book, "Born to be Free".

of his U.S. observations to Air Chief Alksnis, he mentioned the wide interest which parachute jumping could arouse. He suggested that the interest of the Soviet population, and particularly the young, could be turned toward the development of air power by this type of propaganda. Alksnis passed the comment on to the Politbureau. Stalin agreed that it was a good idea. The wheels of the bureaucracy started to grind. Articles appeared in the Soviet press describing parachute jumping in glowing phrases. Parachute clubs were formed. Parachuters were given nation-wide publicity. Youths lost in the anonymity of the mass discovered that they could get into the spotlight by participating in the new pastime that was open to all. Girls, as well as boys, joined the clubs.

The radio and the newspapers told of the exploits of the parachuters. Parachuting became for Russia what football and baseball are to the United States. Jumps were made under varying conditions—at night, in winter, with military equipment, in companies. There were competitions in delayed yanking of the ripcord. Naturally there were accidents but they were lost sight of in the wave of enthusiasm that swept Soviet youth for the new sport. The radio would announce that Ivan Petrov, son of peasants who had come to Moscow to work, was returning home for a visit. He would not come by railroad or on foot, but he would drop at his father's door from the skies. Ivan's parachute jump to the village below was enough to keep the peasants talking for weeks on end.

The result was that thousands of young Soviet citizens became expert parachuters. Many of them developed a real interest in the airplane and were taken into the air force. This had

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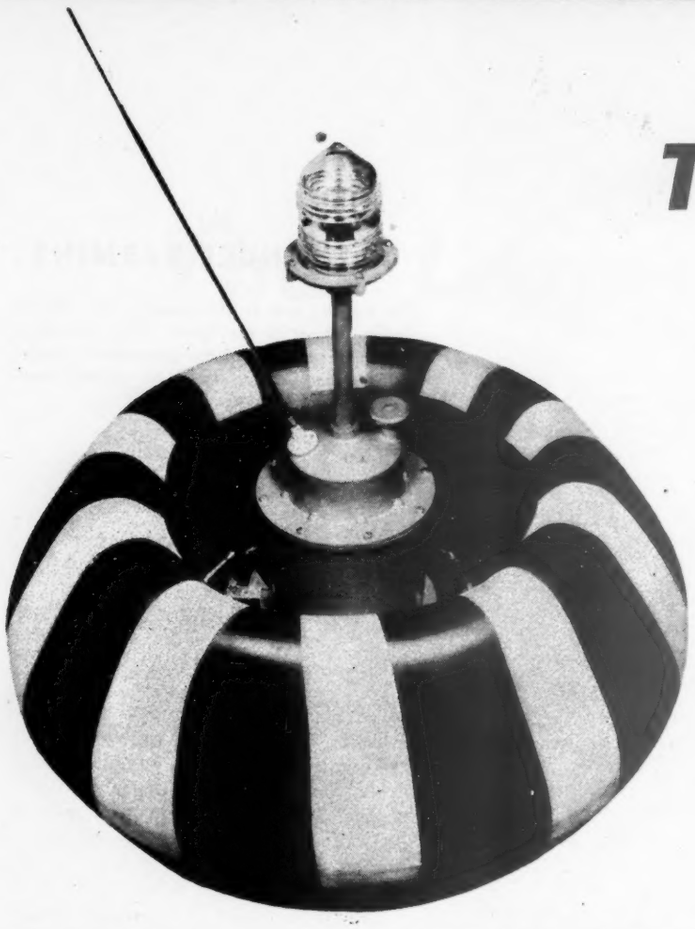
The Seadrome

Westinghouse provides directed fluorescent lighting that now makes possible night operations at marine bases.

By W. A. PENNOW
Westinghouse Electric & Manufacturing Co.
Cleveland, Ohio



Close up of a Westinghouse seadrome contact or boundary light. The Fresnel lens directs a pathway of light rays onto the channel. The rubber base is inflated with a low pressure.

IN AN inter-continental war, seaplane bases assume an urgent importance. The development of seaplane transportation is definitely dependent on adequate lighting of water areas for night landings. The use of the seaplane in military as well as civilian aviation has been greatly retarded without such means of night operation.

Until recently it was only practical to use the seaplane during daylight hours since safety must be the first consideration. Flying boats had either to take off and land during a period of consecutive daylight hours, or take off at dusk and remain aloft until dawn. Emergency landings could be made by dropping flares that would float—but this just couldn't be done in harbors without serious fire hazard to surface shipping or surrounding shore structures.

The problem of seabase lighting has been approached from many angles during the past decade. But there was little success until the development of the Westinghouse Seadrome Contact and Boundary Lights, which now promise to bring the seaplane's enormous carrying capacity to many cities and industrial areas. Even more important, the use of these new units will double the effective use of our fleet of Navy Patrol Boats, and the famous PB series.

Previous attempts to light landing areas on water consisted mainly of trying to floodlight such areas. This was almost 100 percent failure, as the water reflected the light striking it making it seem only blacker by comparison. Depth perception was absolutely nil; the pilot had no way of knowing whether he was 5 or 50 ft. above the water. Other attempts were made to install marine type lights or small floating lights in a line along the surface, with these, the pilot attempted to land along side the line of lights, assuming they represented the surface. This method had some promise, but in order to minimize collision hazard, the buoys, or floats, had to be small and very unstable even in smooth water; thus the line of lights assumed the appearance of a writhing snake, which was disconcerting to the pilot. It was impossible to establish a true perspective of the water surface. As the smallest stable marine type buoy weighed about 4 tons, and since the weight limit of the complete unit for use on a seadrome appeared to be about 200 lb., the development of a small stable buoy was quite remote.

The best answer to the problem came when an entirely new type of floating unit was developed. This was a rather crude, complicated device, but the results were astounding compared to previous methods. The unit consisted of: a dry type battery, a power unit to convert the low voltage dc to full wave high voltage ac, and small fluorescent lamp. These were mounted in a full swiveling gimbal ring attached to the rim of a large airplane tire. The fluorescent lamp with its low brightness, but large light output, gave none of the deceptive shimmering dazzle for which all previous high brightness lamps had been condemned. The gimbal mounting allowed the tire, acting as a buoy, to follow the shifting contour of the water's surface without causing any appreciable movement of the light. The result was a line of lights that, by comparison, remained as steady and solid as a row of contact lights on a concrete runway.

Preliminary tests showed so much promise for this radically new piece of apparatus that an intensive study was begun immediately to discover all possible limitations and to redesign the unit, using components built to rigid requirements. Tests made of rubber for the buoy showed that it was possible to use a flexible wall structure and still make it self-stabilizing, eliminating the gimbal mounting with its many parts. Many theoretical shapes were calculated and results determined mathematically. Finally a shape was agreed on by all the interested engineers and a mould was built for it. This shape was a diamond cross section in revolution. The theory of the diamond included such factors as resistance to side slip on the slope of a wave, ability to ride level when straining against tide or stream flow, and ability to remain upright in choppy water.

The physical size of the buoy was determined by the estimated load it would

Lighting System

have to carry, plus the area necessary for daytime visibility. As all of the available data on buoys covered rigid wall structures, the engineers had to develop all new theories and formulas for the flexible wall units.

Tests on the first buoys produced showed marked improvement in stability over any previously known structures, but the stability did not reach the theoretical values expected. Further study disclosed that the design was very critical as to the rigid wall area of the lighting unit in relation to the flexible wall area of the buoy. A slight change in the area ratios produced the expected stability.

One of the most important considerations in designing the buoy was to minimize the effect of collision with surface craft. By determining careful balance between wall thickness and total inertia, sufficient resilience was obtained to insure less than 25 ft.-lb. impact under any expected conditions.

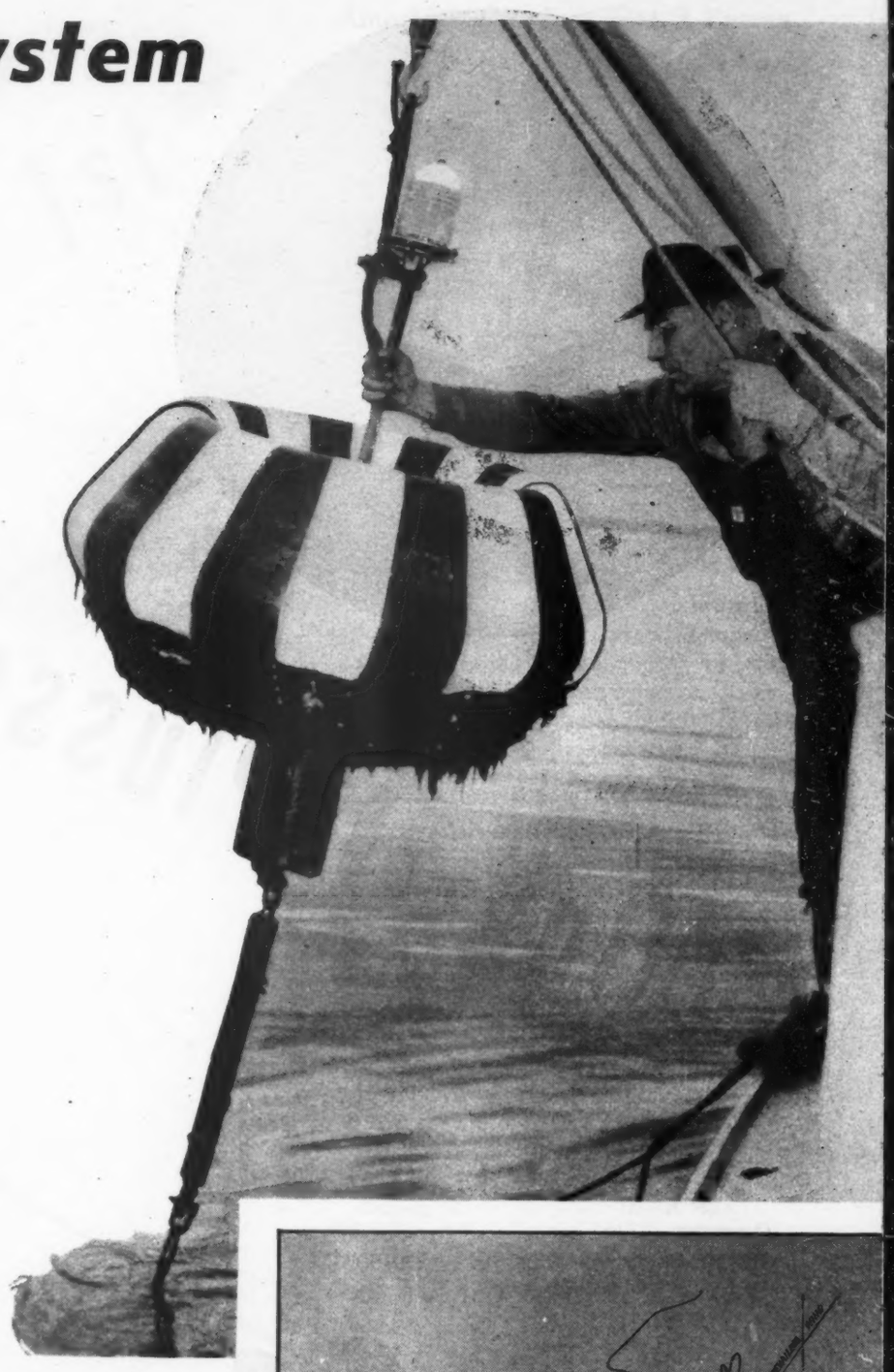
Meanwhile the light unit had been physically redesigned to fit the new buoy structure, the gimbal had been discarded, and the size of the unit was greatly reduced. A basket type mounting was developed so the light unit could be removed for servicing without disturbing the buoy or its anchorage.

Service tests on a group of the new units showed very satisfactory results as to stability and visibility. Several minor structural changes were made during the service tests, which covered about one year under actual operating conditions, resulting in well balanced mechanical strength, reduced battery consumption and increased light output.

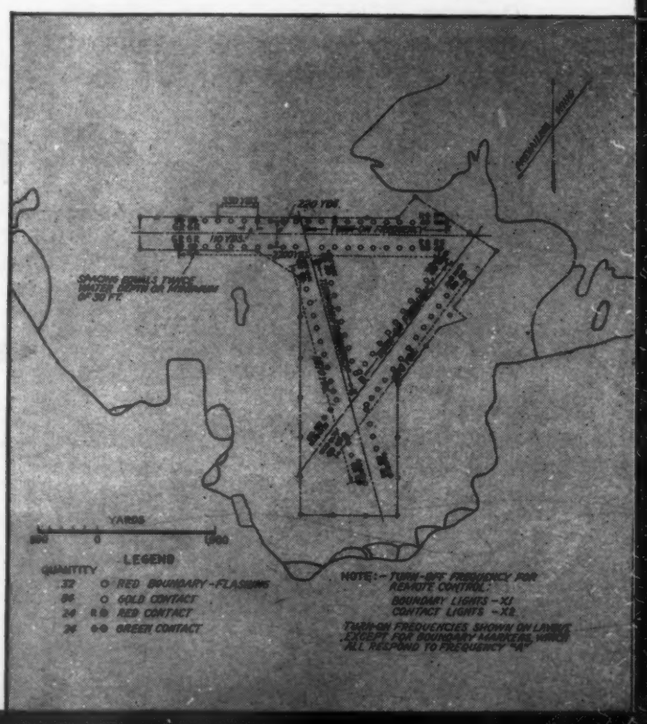
Two sizes of units were made available: a large unit for use at established seaplane bases where permanent runways, or landing channels, are set up; and a portable unit for use at temporary or advanced bases where a landing channel is established only during actual operations. The larger unit is known as the fixed base unit.

The portable unit is controlled by a switch operated manually when the unit is to be turned on or off. Usually the portable units are tied in a line, towed into a position by a motor launch and held in line during the operation by having the launch maintain way at one end of the line while the sea anchor holds the other end. The portable unit is also available with radio control units.

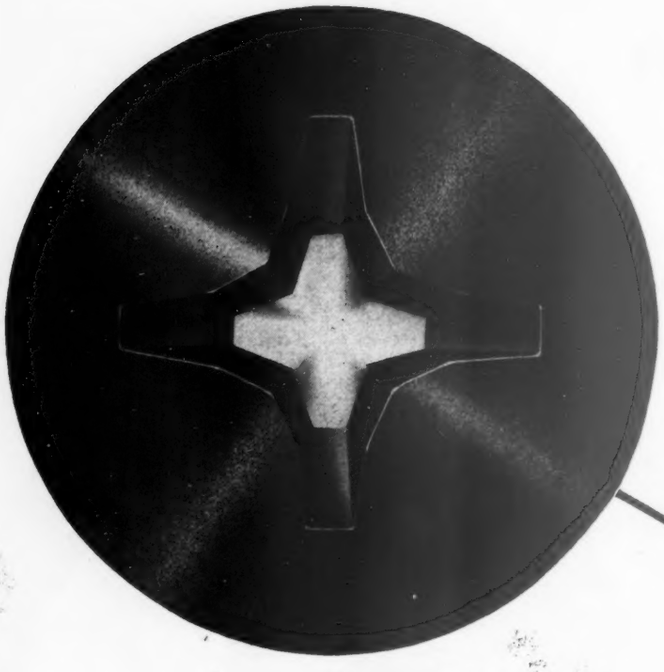
(*Turn to page 203*)



Above: Seadrome contact light being raised for inspection. The lights are visible for a distance of three to five miles, depending on their color, and have a 90 percent atmospheric transmissivity.



Right: Marker plan for a typical seadrome lighting waterway.



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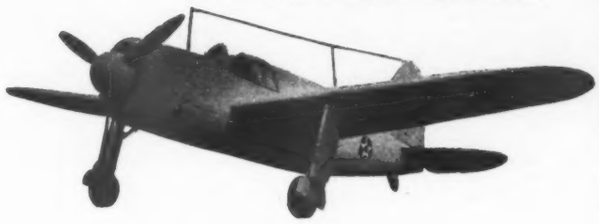

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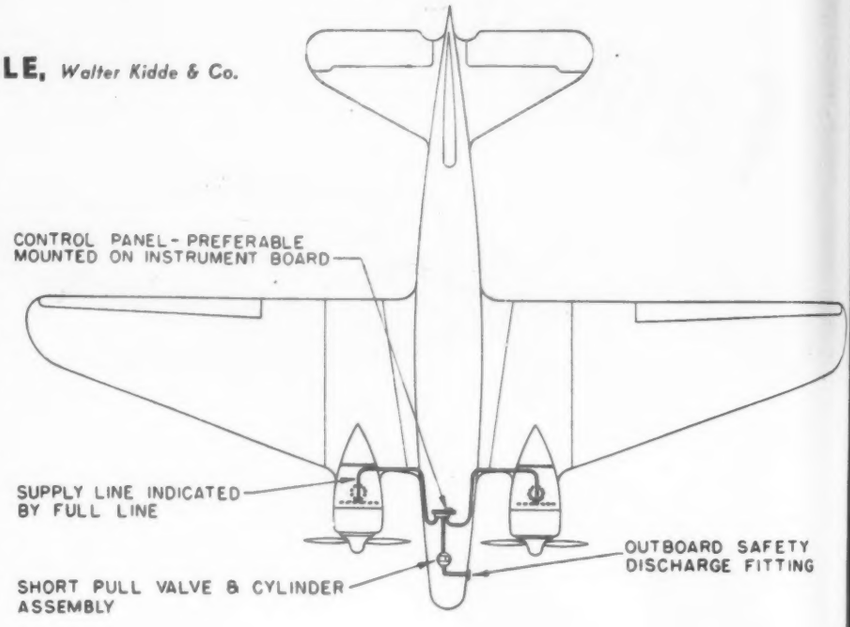
Pertinent advice on the prevention of engine fires in aircraft

By J. M. NOBLE, *Walter Kidde & Co.*

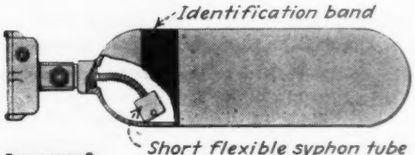

CONTROL PANEL - PREFERABLE MOUNTED ON INSTRUMENT BOARD
SUPPLY LINE INDICATED BY FULL LINE
SHORT PULL VALVE & CYLINDER ASSEMBLY
OUTBOARD SAFETY DISCHARGE FITTING

IT is possible to protect airplanes from engine fires by means of carbon dioxide gas. The pilot simply pulls a release control and the compartment is instantly flooded with a blizzard of carbon dioxide gas, expelled through a perforated ring of tubing.

The accessory compartment is the space which receives attention from the extinguishing system. It is here that the gas is discharged, since it is in this part of the engine that the greatest hazard is present. In addition to the perforated ring which blankets the engine with its discharge, there is usually installed a nozzle which delivers carbon dioxide gas directly into the carburetor scoop, thus purging this vital spot of any sign of flame.

Built-in carbon dioxide fire extinguishing systems usually consist of the following: a small specially-machined lightweight steel cylinder fitted with a quick release valve and containing 7¼ lb. of liquid carbon dioxide; a perforated tubing system and the carburetor nozzle which conduct and distribute the gas; pilot's control handle located in the cabin, preferably mounted on the instrument board; and a distributing valve directing the discharge to any motor of a multi-engined plane, also located in the pilot's cabin.

Fig. B. Cylinder with identification band for a horizontal installation.



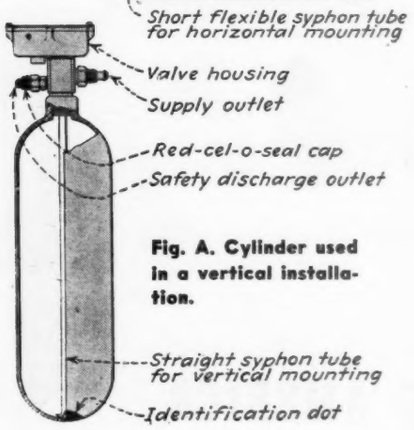


Fig. A. Cylinder used in a vertical installation.

SAFETY VALVE

Since the carbon dioxide gas is stored under pressure, safety dictates that the cylinder should be discharged when the pressure is increased by high temperatures. Each of these systems is equipped with a safety disk which releases the gas when a temperature of approximately 130 deg. F. is reached. A red celluloid cap is fitted over the safety discharge outlet. The rupture of this cap indicates at a glance that the cylinder has discharged prematurely due to high temperatures. If the cylinder is to be located in such a position in the airplane that a premature discharge of the gas would enter the pilot's compartment and create a temporary fog, it is recommended that an outboard safety discharge line be installed, which allows such a premature discharge to release the gas outside the airplane.

GENERAL INSTALLATION

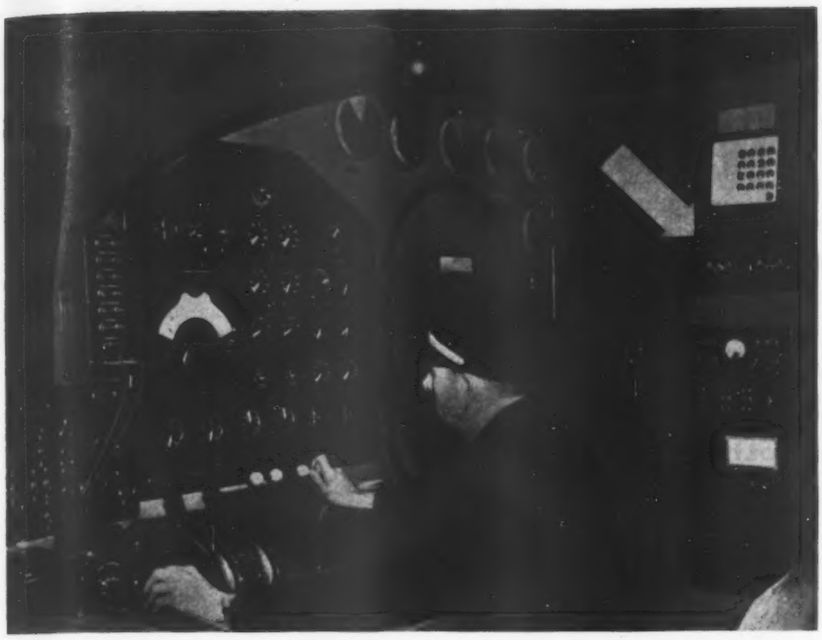
In discussing the installation of a carbon dioxide extinguishing system in a commercial plane, we shall assume that it is a twin-motored plane, with each motor to be protected.

The carbon dioxide cylinder may be mounted anywhere in the fuselage. There are two factors in selecting its location. First, the control cable tubing should be as short and straight as possible, and the gas supply tubing as direct as is practicable. Secondly, do not select a cylinder location which will subject the cylinder to a temperature in excess of 130 deg. F.

TWO TYPES OF CYLINDERS

The carbon dioxide cylinders may be mounted either vertically or horizontally, but it should be noted that there is a special type of cylinder for each of these positions. Details are given in Fig. *A* and *B*. Cylinders that are to be mounted *vertically* are equipped with a straight and rigid syphon tube which extends to the bottom of the cylinder. These cylinders are stamped "S" on the valve body and a black dot 2 in. in diameter is painted on the bottom of the cylinder. It is preferred that those cylinders be mounted in a vertical position, but if it is necessary to tilt them, the angle of tilt should not exceed 30 deg. from a vertical position. (See Fig. *A*).

The cylinders designed for *horizontal*



Flight engineer's station in a Boeing Clipper. The center panel at right is the remote control for the built-in Lux engine fire extinguishing system.

mounting have a short flexible syphon tube as is shown in Fig. *B*. The valve on these cylinders is marked "SF" and carries a black band around its circumference. This type of cylinder should be mounted parallel to the thrust line, or with the valve end tilted *down* to a maximum of 30 deg.

It can thus be seen that it is important that the correct cylinder type (*vertical* or *horizontal*) be specified, depending upon the position which the cylinder will assume when installed in the airplane.

CHECKING THE SYSTEM

Before installing the cylinder, weigh it to determine if its content corresponds with the "full" sign stamped on the valve.

Another check is provided by a little window in the valve. This window should show clear. If the cross on the indicator is visible, it is a sign that the valve on the cylinder has been operated and the cylinder is therefore empty and recharging is necessary.

CYLINDER INSPECTION

Actual installation of the cylinder is quite simple. Fasten the mounting bracket to the member or bulkhead selected and fasten the cylinder securely in place, with outlets facing the desired direction. In selecting a spot for the installation of the control panel in the cockpit or the pilot cabin, observe the same general rules as in the location of the cylinder. Select a location where the control tube runs as short and straight as possible from the cylinder, since this is a factor in easy operation.

Since it is necessary to direct the carbon dioxide charge to either one of the plane's two motors there will be a directional valve also mounted in the cabin. This valve is set in a neutral position. In this position it cannot be discharged, the pilot must turn the indicator to "left motor" or "right motor" before pulling the release.

It is not our purpose in this article to discuss in detail the installation of the tubing. The sizes and specification of tubing and fittings depend, of course, upon the size of the system, which may run from 5-lb. carbon dioxide capacity to 15 lb. or more. However, make sure of these precautions: the cross-sectional area of the tubing must not be decreased in bending. The radius of any bend in the tubing should not be less than $1\frac{1}{2}$ in. Use fittings where a sharper bend is required. Likewise, keep the tubing straight for at least $2\frac{1}{2}$ in. back from each flare. This allows the sleeve to be backed off when making or breaking connection.

These instructions apply to the tubing that handles the carbon dioxide—the supply or distributing tubing. In the case of control cable tubing, do not make any bends. Adjustable corner pulleys should be used, since the pilot's release should operate with the greatest possible ease.

With regard to the attaching of the perforated distributing tubing, one nozzle is connected with the carburetor scoop and the perforated tubing itself is fastened securely to the engine mounting ring. The chief precaution in this connection is to make certain that none of the fastening clips cover up perforations in the tubing. Since more than one engine is being protected there will be distributing cocks for each motor, and to these are attached the supply lines leading to each engine nacelle.

In some cases, as mentioned above, the discharge of the carbon dioxide from the safety outlet might enter the pilot's compartment and create a temporary fog within the cockpit. An outboard discharge then must be provided. The fittings for this discharge are usually shipped with a complete extinguishing system. It is advisable to choose a location for this discharge outlet which is easily visible for inspection, so that the red celluloid disk can be readily seen when the system is being inspected.

POINTS ON CABLE INSTALLATION

It should be repeated that the control cable should be kept as short as possible in order to minimize the pull required to release the carbon dioxide fire extinguishing system. Likewise, it has been found preferable to enclose all control cable and tubing in order to prevent accidental discharge. In some cases, the plane's structure will give a natural protection to the cable in such a way that it cannot inadvertently be caught during the course of repairs or operation of the plane. In such cases it is all right to let the cable remain uncovered.

MAINTENANCE

It is recommended that carbon dioxide fire extinguishing systems be checked every six months by weighing the cylinder. This procedure has been previously referred to. You simply remove the cylinder from its bracket, weigh it, and have it recharged if the weight falls under the specified amount by 4 oz. or more.

These weights are recorded on the valve body. The most careful safety practice is to have a complete checking of the operation of the system. It is necessary to have one inspector sit in the plane's cabin to check the operation of the controls, and another inspector observe the action of the gas when it is discharged into the motor compartment.

If at all possible, the test should be made with the airplane trimmed in flying position. Set the directional valve in the cockpit to either of the motors. Then hook a spring-balance scale under the pull handle and pull slowly until the system operates. The force required to release the carbon dioxide gas should not exceed 40 lb.

Private Flying And the War

Now that the smoke has cleared somewhat, it doesn't look so bad after all. Private flying, save for a few restrictions which are natural under the circumstances, hasn't been too badly hit.

AS THE excitement and confusion of the present War Crises simmer down and calm minds come back to play, it appears that private flying hasn't been so badly hit after all. The cold grey Monday morning (December 8) hit every private pilot as one of the bluest of all Mondays. Private flying grounded; the Judgement Day here at last. Nasty, wild, rumors of gale velocity circulated that everything was washed up. It appeared that the 2,000 plus commercial airports were out for the duration;—those airports which private flying and private enterprise had established, those airports which had made America what it is today;—a nation of 181,000 pilots flying nearly 20,000 civil planes, totals which nearly equal the aggregate of civilian aviation in all other nations combined before the War started in 1939.

Now that the smoke has cleared, it doesn't look so bad after all. Private flying, except on the coast lines is apparently on a "business as usual" basis. Beyond the 150 mile stretches on each coast, few restrictions exist outside of the reinstatement of licenses which is a fitting and proper method of determining loyalty, citizenship, and good intentions of the pilots. It is true that some of the heaviest private flying is in New England, the Middle Atlantic States, and the west coast, particularly California. For those areas where the restrictions practically prohibit non-military flying, the blow is felt worse. But the vast part of the country between the two restricted areas leaves plenty of space to let civilian aviation grow and prosper.

The Civil Air Patrol got a shot in the arm which it badly needed. Before the emergency the organization of the C.A.P. appeared to be something which could easily be put off until "tomorrow." Now it's being organized with a definite role to play. Long thought of by even private flying's ardent enthusiasts as merely a nice plaything, the C.A.P.'s position in national defense is becoming more and more clearly realized. With full endorsement of the Army and Navy, it apparently is seen now as a necessary adjunct to our home front. The fact that General Curry was taken from an active and important command to head the C.A.P. indicates that Washington sees tremendous possibilities for this group. The C.A.P. is definitely needed and needs the definite support of every pilot and plane owner in the nation.

* * *

One phase of private flying which is thoroughly effected by the new regulations is the use of any hay pasture for a landing field. From here on out, all operations must be from "established landing fields". There are hundreds of farmers, ranchers, and other similar people who have accepted flying as a necessary part of their daily living and who keep a plane in the barn alongside their automobile. Few, if any, of these people find that their back yard airports are "established landing fields", and their plight is saddest of all. Possibly the regulations will cause the biggest rub right among these people. Whether their "airports" can be designated as established landing areas is not readily ascertainable at this point, but there may be some hardship among people who rely on airplanes for their farm work and transportation.

The outlook for the fixed base operator is blackest right at the moment, but will improve possibly by the time this is printed. There seems a very great possibility that C.P.T.P. will be greatly enlarged as the value of this training has been convincingly proved. C.P.T.P. graduates have become instructors in large numbers, make up two-thirds of the Eagle Squadron, have joined the Army and Navy Air Forces by the thousands. The Civil Air Patrol will need the guidance of the experienced pilots in each neighborhood which in nearly every case involves the local operator. The sale of ships to C.A.P. units can be counted on at a reasonably steady rate, and of course, maintenance and servicing of these ships will continue to provide revenue for the operators. Best advice to stunned airport operators is to wait a month or so before doing anything drastic.

* * *

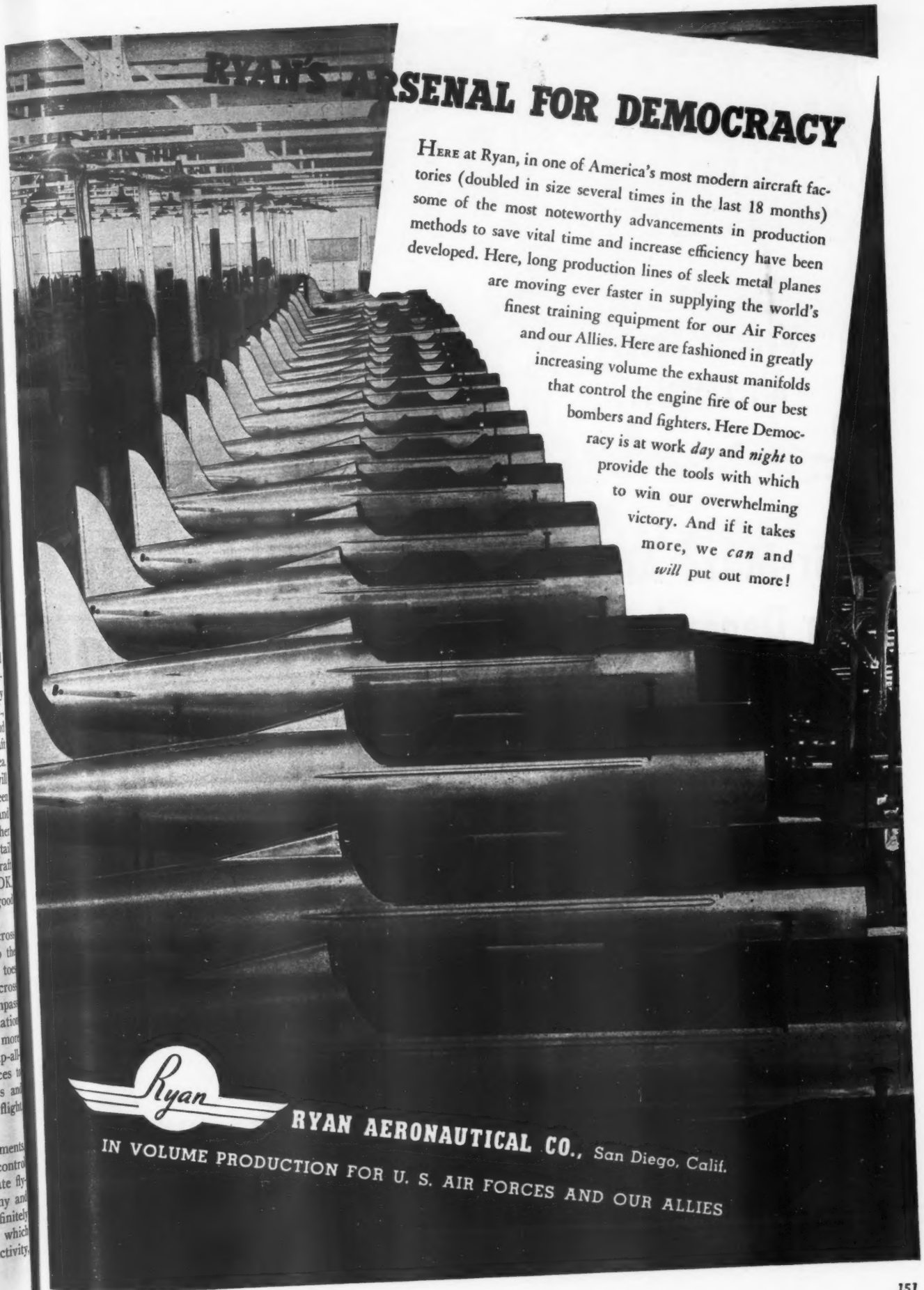
They're not fooling any more about flying over restricted areas. Time was when a private pilot was politely notified that he had trespassed over an Army or Navy installation and that's all there was to it. It's "shoot first and ask later" from now on and private pilots who, up till the present, haven't taken restricted areas too seriously had better change their minds. Typical warnings to private pilots are gleaned from the latest "Weekly Notices to Airmen". Here are samples: ". . . . any planes flying over Portsmouth, N. H. will be considered enemy planes and will be fired upon." ". . . . All aircraft to avoid Parker Dam, Arizona, area. If aircraft approach this area, they will be fired upon." There has already been at least one case of shooting first, and this occurred near Baltimore. A rather surprised pilot found most of his tail shot off flying too close to an aircraft factory. Fortunately he landed OK, but he learned a lesson which is good warning to every one else.

The new rules should not effect cross country flying a great deal, only to the effect that a pilot has to be on his toes and can't barge off aimlessly on a cross country flight. Plotting a compass course and waiting until the destination shows up must be discarded to the more accurate and careful read-the-map-all-the-time technique. Weekly Notices to Airmen, are posted at all airports and should be consulted before each flight.

* * *

In the light of recent developments (organization of the C.A.P. to control private flying, restriction of private flying along coastal areas) the Army and Navy have officially and most definitely admitted that light airplanes, which form the bulk of civilian flight activity,

(*Turn to page 201*)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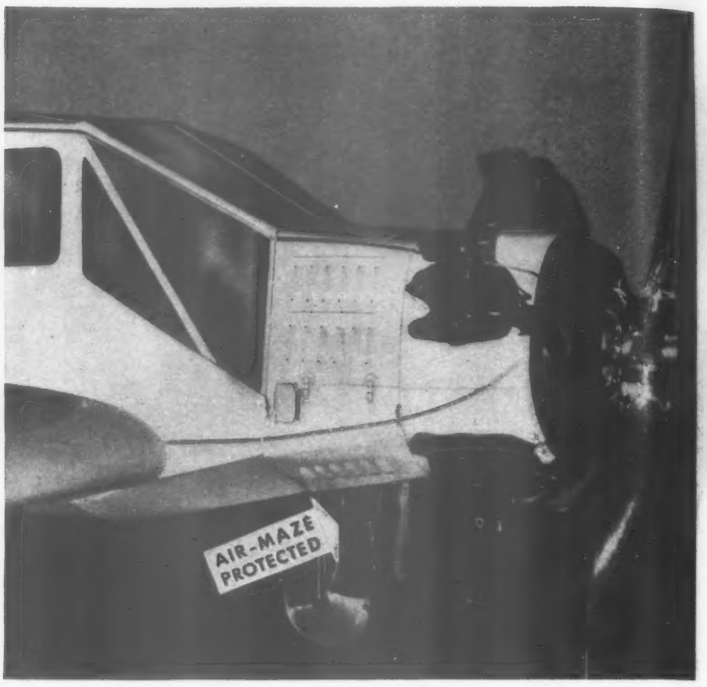

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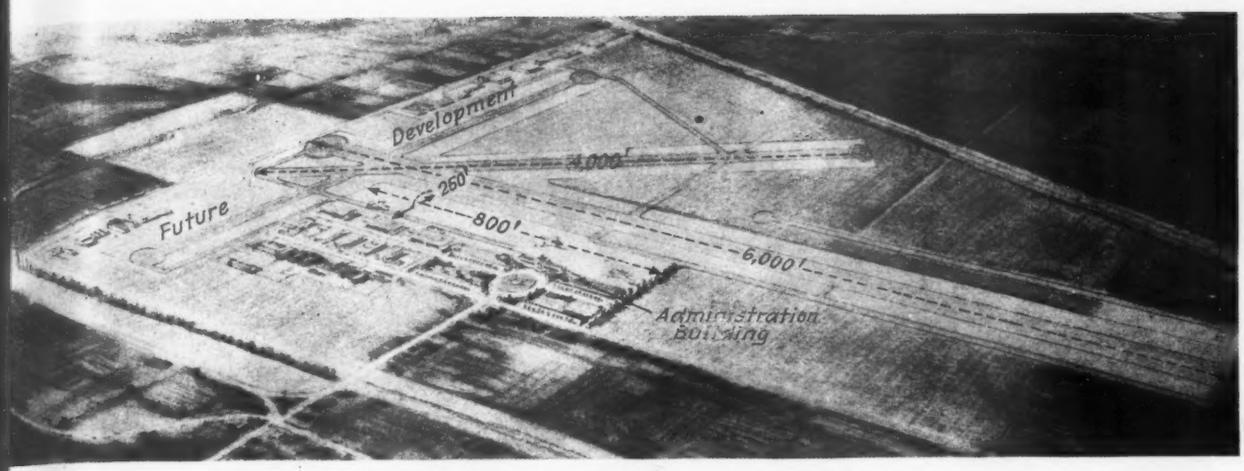


Master plan for Ontario, Calif., Municipal Airport

Defense Grant Aids Small-Town Airport

Airports, more than most projects, require far-sighted planning—Ontario, Calif., looks to the future

By **DONALD R. WARREN,** *Structural and Civil Engineer*

NATIONAL DEFENSE requirements render imperative the establishment of adequate auxiliary fields in the neighborhood of the large new air bases. Furthermore, it is to the advantage of all towns, large or small, to provide themselves with the best possible airport facilities for military, commercial and private owner flying. This is especially true in Southern California, where there is such a heavy concentration of aircraft manufacturing and other forms of aeronautical activity.

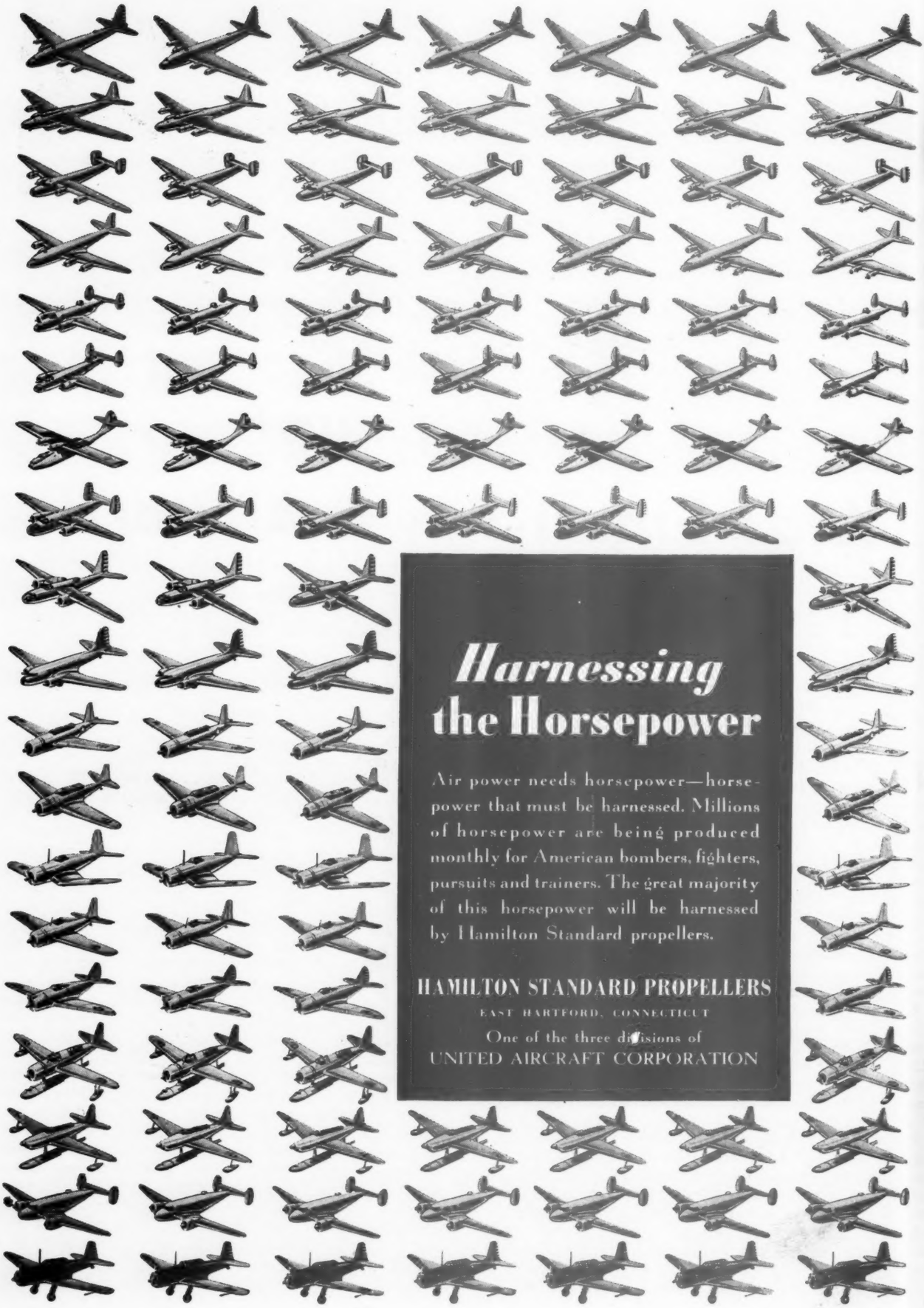
Recently the city of Ontario, Calif., which is just outside the Los Angeles County industrial area, adjacent to the March Field air base and the primary-basic training center operated near Ontario by the Cal-Aero Corp., decided to provide a new municipal airport.

The City of Ontario voted a bond issue of $150,000. A Federal Defense grant brought the total funds available for the airport to $501,300. It was decided to plan the airport in accordance with the most modern engineering practices and the author's firm was engaged for this work.

Complete subsoil analyses and preliminary investigations were made to determine the most effective and economical type of paving. Local air currents dictated a main runway running east-west, and the requirements for heavy bomber operation established the length of runway at 6,000 feet. To satisfy the structural requirements of the foundation material, the landing strip, 150 feet wide, was designed for Portland cement concrete, having a section of 8 x 5½ x 8 in. of 12 feet, 6 inch lane. This concrete strip is flanked by 25 feet of 4-inch roadmix. Taxiways are designed for 4-inch plantmix surfacing, and the remainder of the 560-foot wide runway is surfaced with 1½-inch roadmix, which satisfies the requirements of lighter planes. The paving on this main runway is approximately of the same surface and equal to 30 miles of two-lane highway. To provide for emergency landings when the air currents are not east and west, and in order to provide for all-season flying, a diagonal runway 4,000 feet long and graded for a width of 500 feet will be constructed.

A concrete warming apron 250 feet wide and 800 feet long is provided in front of the administration area. Lighting, drainage, and water facilities have been designed to meet the physical conditions and future requirements of the site.

Scheduled for completion next summer, this airport is located just 36 miles east of Los Angeles and is bordered on two sides by major highways and transcontinental railroads. The master plan for the airport sets aside areas for the future development of the site with special reference to industrial purposes. Due to its location with respect to Los Angeles, the existence of ground transportation facilities, and the good weather conditions prevailing, this field should prove popular for many aviation activities in addition to serving a vital purpose in the government defense program. The designer of the airport has had the fullest cooperation of the local officials of the Works Progress Administration and the Civil Aeronautics Administration in expediting the preliminary work. All work has been done under the personal supervision of Neal Smith, City Manager of the city of Ontario.



Harnessing the Horsepower

Air power needs horsepower—horsepower that must be harnessed. Millions of horsepower are being produced monthly for American bombers, fighters, pursuits and trainers. The great majority of this horsepower will be harnessed by Hamilton Standard propellers.

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The AVIATION NEWS

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18 Billion of World's Biggest War Fund Goes to the Army and Navy for Airplanes One Billion for New and Converted Plants

Washington (AVIATION Bureau)—By far the biggest business deal in history was made by Congress in appropriating about $38,000,000,000 last month for war production, and about $18,000,000,000 of it is for airplanes. This is the country's backing for the President's program of 185,000 planes in two years, which, combined with other production of the United Nations, will snow the Axis under, in air power, nearly three to one.

The appropriation provides 33,000 planes for the Army, 10,000 of which will be training types, and 23,000 will be combat. It was unofficially estimated that Navy was getting money for 25,000 planes, in addition to a provision, a few days earlier, calculated to increase Navy's production from 500 a month to 1500 a month.

First one of the series of gigantic appropriations was the 12½ billions for Army planes. Along with it came one for about 20 billions for the Navy, all for surface ships except the increase to 1500 planes. When this Navy bill reached committee, it was increased by five billion and other amounts, totaling over six billion for planes. The Navy bill finally came out totaling 26½ billion dollars.

The Army's airplane bill, totaling 12½ billion, calls for: $993,000,000 for conversion of auto plants to aircraft production and for assembly plants, the number of which can no longer be stated; $9,041,373,090 for procurement of 33,000 completed airplanes; $680,000,000 for the Signal Corps, mostly radios for planes, communication facilities and locating devices; $1,547,948,529 to the Ordnance Department for airplane guns; $323,308,675 to Chemical Warfare for incendiaries, flares, smokescreen, etc.

This airplane program does not entirely meet the Army's share of the total 1942 60,000 planes and 1943 125,000 goal set by the President. Additional appropriations are still to come. This fund will (1) prevent a decline in production that would occur next August when existing orders begin to run out; (2) provide orders to fill up new plants which will be in production by then, and (3) increase capacity for heavy bombers. Entirely new construction will be limited mainly to bomber assembly plants and plants for production of explosives and incendiaries.

Both Knudsen and Patterson recently informed congressional committees they did not contemplate expansion of airplane plants in coastal regions exposed to attack.

The Government's new Office of Facts and Figures, says that in 1942 this country will build more airplanes than Germany did in all the years before 1939 when she was preparing for the war.

Touring Congressmen inspect a Martin PBM-3 patrol bomber at the Glenn L. Martin plant. It is to be hoped that more Congressmen will visit more aircraft plants to learn about the industry's work for a background to their discussions on wartime profits.

Spring CAA Program

The Spring program of CAA pilot training was launched, according to Charles I. Stanton, Acting Administrator of the Civil Aeronautics Administration, in coordination with the requirements of the armed forces of the nation. Major changes in student requirements, in line with the total war program, include dropping the age limit of applicants from 19 to 18, acceptance of married men if their dependents have means of support, and the signing of an affidavit by applicants that they will, at the completion of their course, make application to join an armed air service, or if preferable, take an advanced flying course.

The program as now outlined will have approximately the same scope as the last two sessions, calling for the training of 8,850 elementary fliers and 3000 secondaries. Also 4500 instructors, cross-country and ferrying pilots will be put through advanced courses.

WPB Takes Over OPM Divisions

No one need be confused about the new War Production Board which replaces the OPM. The only real difference is that one man, Donald Nelson has almost absolute authority over production. He can even tell the Army and Navy it can't have this or that. He is responsible only to the President.

Under WPB are all the same Divisions that were under OPM: Purchases, Production, Materials, Labor and Civilian Supply. But a new one is added, the keystone of them all: the Division of Industry Operation, under J. S. Knowlson. This division is charged with converting the nations plants to war production. And it includes priorities. Contract Distribution is included in Production Division. Conservation is included in Materials.

Nearly everything is done the same as it was before.

In charge of the task of turning out 30,000 new flying personnel for the 1942 production program is Maj. Gen. Barton K. Yount, Chief of the Training Program.

Vinson, Truman, Harter Report on Aircraft

Washington (AVIATION Bureau)—Three important reports on congressional investigations of war production, all affecting aviation, have been published lately.

Rep. Carl Vinson charged in his report that airplane manufacturers were taking inordinate profits on government contracts. This document contains a vast amount of information, some of it objected to by Service officers as confidential.

Sen. Harry S. Truman carried these charges still farther, and accused the Administration of weakening our air forces by shipping planes abroad. He deprecated the

quality of U. S. airplanes, and said that they cost far too much.

Then Dow W. Harter, of Ohio, displeased with Truman's charges, published an interim report defending the Services and the aircraft industry. He showed that research, design, and production of planes is satisfactory, and the Service manpower is being trained with maximum speed.

Eugene Wilson, president of United Aircraft, said that Vinson was mistaken; that he had used gross earning figures, and that Company's profits on $500,000,000 in contracts would be less than three percent. Most observers here felt that all of the reports were legitimate efforts, and that they had served a good purpose.

U. S. Navy Will Train 30,000 Pilots a Year At Four Colleges; They'll Be Tough Hombres

Thirty thousand tough air scrappers annually is the goal of the vast new air training program announced by the Navy and Marine Corps.

This program, to begin functioning by May 1 at four large universities to be rented for the "duration" by the Navy, is expected to begin turning out finished fighter and bomber pilots within a year.

The four universities, each of them to be known as an "Annapolis of the Air" will take in approximately 2,500 cadets monthly. These cadets will face what is deliberately designed to be the most rigorous toughtening process in the whole 150 years of the country's history.

Secretary Frank Knox, himself a Rough Rider and veteran of the First World War, admits, with considerable understatement, that this training "will not be easy." He adds that "we want men who can take it--and give it back."

Ground work of the plan was laid even before Pearl Harbor, under direction of Assistant Secretary of the Navy for Air Artemus L. Gates, himself an ex-Navy pilot, and Admiral John H. Towers, a pilot, of the Navy's Bureau of Aeronautics.

Lieutenant Commander Thomas Hamilton, U.S.N., ex-football coach at Annapolis will be in charge of the physical training. He will be aided by Lieutenant Commander James (Gene) J. Tunney, former world's heavy-weight champion.

The four universities are to be used solely as ground schools. They are to be located in the four quadrants of the country, and arrangements are virtually completed, say Navy officers.

From the moment he becomes a candidate for cadetship, the embryo aviator is going to be up against it hard. He will be physically tested by cold-blooded medicos, and from them on will be under expert medical supervision.

The courses of training have been announced as follows: proper physical conditioning, indoctrination in naval history and customs, military drills and seamanship, and training in communications, ordnance and other special subjects.

Their preliminary training completed, the embryo Navy pilots will be sent to one of the 16 naval reserve aviation bases for actual primary flight coaching. Pains will be taken that they keep their toughness acquired at the preliminary schools. The primary work done, the cadet will be ready for the Navy's advanced flying schools, where the final polish will be given the flier.

New Regulations For Pilots

Beginning February 15, U.S. civilian pilots who have proved their citizenship and loyalty may continue their pre-war activities under a system of controls designed to protect the nation, their airports, and their planes against saboteurs, and to hold their craft ready for service in any possible military emergency. The rules were worked out by the Civil Aeronautics Board at the request of the War Department in cooperation with the Civil Aeronautics Administration.

Regulations have been prepared to eliminate confusing local restrictions, many of which have been troublesome to civil pilots since war began, said Charles I. Stanton, Acting CAA Administrator. Their purpose is to tell all civil pilots what they can do and to modify the rigid restrictions on civil pilots now prevailing in certain areas of the country. Military control will top Civil Air Regulations in case of emergency.

In the new regulatory setup as laid down by the Board the keymen at each airport will be a Registrar and a Clearance Officer, appointed by, and responsible to, the management. They must have the approval of and be designated as such by the Administration, and will be responsible for checking pilot credentials, checking the aircraft for proper registration, and issuing flight clearances.

Pilots will be free to fly as usual if the Registrar and Clearance Officers are continuously informed as to their whereabouts and activities. Local flying will be permitted in areas designated for that purpose in the vicinity of airports, and excluding areas over which local restrictions may be imposed for military reasons. Pleasure and industrial flying may go on, in accordance with the new rules.

To prevent sabotage, 24-hour guards must be established at airports. Airports managers, mechanics, the Registrar and the Clearance Officer can conceivably do the job on a three-shift-per-day basis.

All planes will be registered under the war plan, with full details on their ownership, type, size, and airport at which they are based or place of storage.

The Administration decided that, to make an aircraft incapable of operation as required by the regulations, the aircraft must be completely dismantled and secured from unauthorized removal.

CAP Averaging 1,000 Applications Daily— Uniforms Being Designed for Members

Washington (AVIATION Bureau)—Civil Air Patrol is getting nearly 1,000 applications daily, from all of the 48 states. At this writing there are about 16,000 volunteers, 85 percent of which are pilots. But the Patrol is open to all citizens over 16. Their jobs consist of guard duty, cleaning hangars, clerical work, etc., or any job that will keep a pilot free to fly. It is estimated that from 3 to 4 groundmen will be needed for every pilot in the air. But the Patrol will not stress the point that they need groundmen until they have sufficient numbers of pilots. Then for every man in the air, they will call up the groundmen as needed.

The Patrol has worked out a program of 12 subjects of instruction, ranging from 2 to 20 hours, for all members of the CAP. Courses include military courtesy, infantry drill, first aid, civilian defense, defense against gas, airport protection, guard duty, crash procedure, and organization of the Army, Navy, Air Forces and the Office of Civilian Defense. Total hours required is 80 hours of instruction.

The expected number of members will approximate 90,000 pilots, 90,000 student pilots, and 100,000 ground personnel. There will be no compensation for work; the only pay will be experience and the satisfaction of helping one's country. A system of "expense" money was talked about for pilots to reimburse them for gas and oil used for government work. But the thought that this would cause dissension lead the Patrol to frown upon the idea.

Plans are underway to try and obtain for CAP personnel

War Plans Division heads shown in conference are Brig. Gen. Leonard T. Gerow (right); Chief, Brig. Gen. R. W. Crawford (left), and Brig. Gen. D. D. Eisenhower (center).

the same weather information furnished by the government to scheduled air transport and the military forces. Also conferences have been held with aviation underwriters to work out policies which will protect personnel while on assigned missions.

Specifications have been approved by the Army Quartermaster for uniforms and a general order will be issued in the future. Uniforms for officers will be the same as the Army but with the Patrol insignia. Ground personnel will wear the regulation private's uniform and mechanics will wear coveralls. This places cost at a minimum and can easily be used for the Army uniform should a member be drafted. Uniforms must be worn while on duty.

Navy Enlists Kids

Secretary of Navy Frank Knox asks high school youth of America to participate in part of the Navy's training program. The Navy urgently needs 500,000 aircraft models —10,000 models each of 50 different types of fighting planes—for training personnel in aircraft recognition and range estimation in gunnery practice; also in the training of civilians in aircraft recognition.

Plans and specifications are prepared by the Bureau of Aeronautics for the Office of Education. The first sets of working drawings will be in the hands of cooperating schools by February 23. Models will be made on a precise scale of 1 to 72—one inch on the model represents 6 feet on the actual plane. The same proportion holds true as to distance; a model seen at 35 feet is identical with an airplane seen as just under half a mile. Studying the models through the standard ring sight used on aerial gun mounts becomes invaluable training for the cadet flyer, teaching him type, identification, and range.

Models will be constructed of wood, furnished by the manual training teacher at the school.

Make Runways Safe

The proper maintenance of runway surfaces is important between now and next summer, says CAB. Pavement surface designed to prevent skidding under all conditions of weather and operation will prove efficient only if thoroughly maintained.

Surfaces get covered with silt, rains turn it to slippery paste, and brakes don't hold. This paste can be removed with power flushing, rotary broom, or air suction or pressure.

Sleet, freezing rain, sheet or glaze ice provided hazards which can be minimized by applying a mixture of calcium chloride and sharp, coarse sand or cinders by hand or machine. CAA has the mixture formula.

CAB Reports PAA Crash

An accident involving a Sikorsky S-42B aircraft, during a landing at San Juan, on October 3, 1941, Pan American Trip 203, Miami, Florida, and San Juan, Puerto Rico, is reported by the Civil Aeronautics Board.

The Board finds the aircraft did not receive landing conditions transmitted over the radiotelephone because the aircraft's voice apparatus failed. The plane, engines, and all equipment, with the exception of the radiotelephone, were functioning normally until contact with the water. Almost immediately after contact the craft swerved violently to the right and broke into several major sections.

CAB gives as the probable cause of the accident, the failure of the captain to exercise requisite caution and skill in landing. The smooth surface of the water which rendered difficult the captain's depth perception, as well as the exact determination of any lateral movement of the aircraft, contributed to the cause.

Model Materials Denied

Manufacturers of flying model airplanes were told by a War Production Board representative that aluminum, rubber and nickel is not available for continued production of the small planes. WPB also indicated at a meeting of model airplane manufacturers that they would be required to give up any stocks of strategic materials which they had accumulated.

CAB's First Report

In its first annual report (as an agency separate from CAA) just issued, the Civil Aeronautics Board summarizes work done in the fiscal year ending last June 30. The defense program imposed many special problems on civil aviation, in addition to those arising from the rapidly expanding industry. The report emphasizes the growth of air traffic and the difficulty of getting equipment to handle it. Statistics on all phases of civil aviation are given. Economic regulation of the airlines; mail, passenger and property rates; international aviation; safety problems; and many other subjects are covered.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Airlines Delivering "Goods"

Office of Defense Transportation, headed by traffic expert Joseph Eastman, mentions air transport, along with railroads, motor transport, inland waterways and pipe lines, as coming under its jurisdiction for any action necessary in the interest of war production. Col. Edgar S. Gorrell, head of the Air Transport Association, has placed the air system at Mr. Eastman's disposal. But at this time, both Eastman and Gorrell see no ODT action necessary.

A first rate job of cooperation with the Administration and all its branches has put the airline system in a better position, relative to the war, than was anticipated by most observers during the pre-war period. Such valuable equipment, personnel, and knowledge as air transport has, could not hope to escape war service. In a word, the airlines are saving their souls and their shirts by saying, in effect, "We will do what you want done, better than you could do it, without worry on your part," and then delivering the goods.

Acquisitive eyes are always on the airlines' planes, pilots, mechanics, weather men, maintenance men, experts of many kinds. Everybody is looking for talent and equipment to complete the tasks for which he is being pressed. And nobody is to blame. Somebody in the Government had to step in as umpire, or a free-for-all scramble would have torn the air system apart. The War Department, having the largest interest, was the right department, and General Connolly, having the interests of both the Army and the airlines at heart, was the right man.

The Stubblefield award goes to the lady airplane spotter in New Jersey who reported two biplanes and a submarine in the air over her post. The sub turned out to be a blimp.

Note to spies: Those futuristic airplane pictures released by Wright Field, are not the real thing; they are rejected designs. The real thing is much better. But you can figure out from the released drawings that somebody has been doing a lot of work on pusher airplanes. The United States is away out in front in that line.

Our designers have developed pusher airplanes for thirty years. We have at this time several excellent small pusher airplanes, and two major projects: the Bell Airacuda and the Northrop all-wing. The Airacuda, a twin-engined all around attack plane, passed a good Air Corps test run, and was laid aside mainly because the Army wanted Bell to rush the P-39. Britain had the single-engined Pterodactyl pusher, and Germany now has the new single-engined Focke-Wulf pusher. Pusher design, with its undisturbed flow of air on the wings, and its good visibility gun mounting characteristics, is something to keep an eye on.

CALLING NAMES

Capt. Paul Foster, Eastern Air Lines' check pilot on the Atlanta-San Antonio-Brownsville, Texas, division, flew nearly 1½ million miles without receiving a scratch then fell from his bicycle and fractured his skull.

W. E. Boeing, pioneer airplane builder,and sportsman, is changing the red circle on his jockey silks, and on his stables, to a red block, which doesn't look so much like the Rising Sun.

Eddie Molloy is elected v.p. in charge of manufacturing for Ryan Aeronautical Company. San Diego.

E. F. Lowe, Society of Automotive Engineers' assistant general manager, is in charge of the newly establishment of a West Coast Branch office, located at 530 West Sixth Street, Los Angeles. Members in this area are engaged in all phases of automotive engineering, including aircraft and engines.

Oliver L. Parks, president of the Southwest Aviation Conference, cancels their meeting for April 23-25 with the promise to meet immediately after peace is declared.

Col. Earl L. Naiden, Air Corps, is nominated to become a temporary Brigadier General.

Lt. Marshall J. Anderson, Oklahoma City, an Air Corps hero, who was killed in action in the Philippines, has been awarded the distinguished service cross.

Maj. Gen. Millard Harmon, Commanding General of the 2d Air Force, Fort George Wright. Washington, has been assigned to duty as Chief of the Air Staff, Army Air Forces, Washington, D. C.

Maj. Gen. Frederick L. Martin, Air Corps, has been assigned as Commanding General of the 2d Air Force, at Fort George Wright, Washington.

Erik H. Nelson has returned to active duty with the Army Air Forces as a lieutenant colonel assigned to the Inspection Division, Office of the Chief of the Air Corps.

Clarence C. West, Jr., v.p. in charge of Traffic & Sales for Continental Air Lines, has been called for active duty with the Army Air Corps.

Paul Carmichael, as General Sales and Traffic Manager, will be in charge of Traffic & Sales for Cintinental Air Lines, with the assistance of R. J. Moulton, Jr. as Assistant Sales Manager.

Robert A. Lambeth, treasurer of North American Aviation, was named v.p. and treasurer; **Raymond H. Rice,** chief engineer, v.p. in charge of engineering; and **J. S. Smithson,** general manufacturing manager, v.p. in charge of manufacturing.

Col. Arthur I. Ennis, chief of the public relations branch of the Army Air Corps, addressed a dinner meeting of Air Service Post 501, American Legion at the Lotus Club, 110 West 57th St., New York, N. Y. Feb. 4.

Univ. of Texas is now offering a correspondence course in air transportation under direction of John H. Frederick.

M. B. Crawford has been appointed to the position of field service engineer of Pump Engineering Service Corp., a division of Borg-Warner Corp.

David C. Adkins of Boston is appointed promotion and publicity manager for Northeast Airlines.

I. M. Laddon is named executive v.p. and g.m. of Consolidated Aircraft Corp.

Gov. J. Melville Broughton of N. C., presented to Sec. Knox a two-engined Grumman amphibian plane from the people of North Carolina.

Aero Insurance Underwriters moved from 50 John Street to larger quarters at 111 John Street, N. Y. At the same time operations of the Eastern Branch office will be segregated from those of the Home office.

Ernest G. Stout of San Diego, Calif., was awarded the Lawrence Sperry Award for a notable contribution to aviation, by the Institute of the Aeronautical Sciences.

NAA headquarters have moved from the Willard Hotel to 718 Jackson Place, N.W., Washington, D. C.

Lawrence Rockefeller has been elected a member of the NAA Board of Directors.

L. Welch Pogue, General Counsel of the CAB, has been named chairman of the CAB.

Lynn H. Dennis is made Supervisor of Stations for Northeast Airlines.

John S. Phipps loses his Grumman G21 amphibian to the Navy who took over the ship.

Continental Can Company sells to Army a twin engine Beechcraft.

Clyde Shockley, v.p. and g.m. of the Muncie Aviation Corp., sold a twin engine Cessna monoplane to Pan American Airways, Inc.

Leon Morrier is appointed district traffic manager of United for New England with headquarters at Boston, succeeding E. J. Whitcomb, resigned.

Jeff Walton, who has served in UAL's passenger service department since 1936 at Salt Lake City, Seattle and Reno, has become district superintendent of passenger service at Oakland.

S. F. Leib, formerly in United's Los Angeles traffic office, has become traffic representative at Long Beach, Calif.

Carl Apponyi is appointed director of public relations of Northrop Aircraft, Inc.

Maj. Gen. George H. Brett and **Maj. Gen. Stanley D. Embick** are nominated for promotion to the temporary grade of Lieut. General; **Brig. Gen. Clarence L. Tinker** to the temporary grade of Maj. General; **Col. Ira C. Eaker** and **Col. Robert S. Olds** to the temporary grade of Brig. General.

Charles I. Stanton, formerly Deputy Administrator of CAA has been made Acting Administrator to replace **Brig. Gen. Donald H. Connolly** who has returned to the Army as Director of Civil Air Activities.

Horace Bassett is now factory manager of Wolverine Tube Co.

Bert M. Brock is new manager of industrial relations for John A. Roebling's Sons Company. He was former director of industrial relations for Pittsburgh District of Carnegie Illinois Steel.

James H. Coolidge, executive vice president of McDonald-Coolidge & Co., is named treasurer of Thompson Products, Inc.

Eddie Molloy, works manager of Ryan Aeronautical, is made an officer of the company. His title is vice president in charge of manufacturing.

L. D. Thompkins, vice president and director of U. S. Rubber Co., is appointed a special assistant to William S. Knudsen of OPM.

Orville E. Mohler, formerly vice president in charge of sales for Menasco Mfg. Co. is now a captain in the U. S. Army Air Corps, stationed at Wright Field.

Victor E. Metzgar, formerly with Lockheed and with Stearman, is chief sales engineer in charge of the Metal Working Machinery div. of Onsrud Machine Works.

David A. Thomas is made manager of the Canadian engineering offices of Adel Precision Products Corp.

James F. Lincoln, pres. of Lincoln Electric Co., was honored at a testimonial dinner attended by more than 100 leaders, at Los Angeles on Jan. 26.

Erik H. Nelson, veteran Army distance flyer and recently aviation consultant for OPM, returns to active duty with the Army Air Forces as a lieutenant colonel.

D. S. S. Macdowall, deputy finance director of British Overseas Airways, is made the Director General's Special Representative for North America, with headquarters in New York, and will act as liaison between U. S., Canadian, and British government officials and the corporation.

William E. Schaefer, formerly of the manufacturing div., Aircraft Section, OPM, is made production manager of Allied Aviation Corp. He's been in aviation since 1915.

Edward H. Conerton, is appointed assistant to First Vice Pres. Ray P. Whitman of Bell Aircraft Corp., resigning as eastern representative of Kinner Motors.

William W. Manville is appointed laboratory supervisor of engineering research for Aircooled Motors Corp.

Allan F. Bonnalie, asst. to executive vice pres. of United Air Lines, is on year's leave to accept executive post with Bureau of Aeronautics, Navy Dept.

Mathias Klein has been named chief production engineer of Curtiss-Wright's middle-west propeller division, and **Edward F. Theis,** plant manager.

Robert Insley, former chief engineer of Menasco Mfg. Co., joins engineering staff of Kinner Motors. **Major Frank W. Seifert** is made eastern representative of the company.

Leon C. Morrier becomes district traffic manager of United Air Lines, succeeding E. J. Whitcomb. **John P. Bowles** is new traffic representative in Sydney, Australia.

C. R. Spears is named eastern traffic manager for American Airlines; **W. Nelson Bump,** New England traffic manager; and **F. J. Robinson,** Canadian traffic manager.

Lynn H. Dennis is appointed supervisor of stations for Northeast Airlines.

B. P. Lester and **Albert S. Knies** are elected to directorate of Rohr Aircraft Corp.

Milan Freese, formerly of sales promotion dept. of Ohio Seamless Tube Co., is named advertising manager of the company.

Sidney E. Collins, manager of the agency dept. of American Airlines, becomes traffic manager in Hartford, Conn.

J. D. McKnight is new asst. district manager of Detroit office of Allegheny Ludlum Steel Corp.

M. B. Crawford is made field service engineer of Pump Engineering Service Corp.

David C. Adkins is appointed promotion and publicity manager for Northeast Airlines, with headquarters in Boston. **Milton H. Anderson** becomes director of the line's pilot training division.

A. N. Lindberg, president of Lindberg Engineering Co. and Lindberg Steel Treating Co., died on February 2nd at the age of 66.

Mrs. Inez Blancett is the only woman district traffic manager in the airline business. She holds that post for Braniff Airways.

Frederic Slader, chief engineer for Curtiss-Wright Airplane Div. in Buffalo, is elected president of the Aero Club of Buffalo; **Andrew B. Newcombe,** American Airlines, vice pres.; **David G. Forman,** Bell Aircraft Corp., treasurer; **Charles M. Vandermeer,** Aluminum Co. of America, secretary.

Harold W. Munday is district engineer in the Chicago territory for Despatch Oven Co.

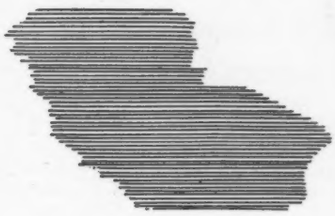
Martin Eliason represents Jessop Steel Co. in the Milwaukee territory.

"They Fly Through the Air . . ."

A device by which aerial torpedoes, bombs and shells can steer themselves under their own power to their target has been patented in Britain. Complete with engine, propeller, gyrostatic controls, etc., it is really a tiny pilotless plane which has a releasing device so that it may shed its wings at the proper moment and so drop on the target.

The bomb is launched by a catapult, an arrangement which not only obviates transport of heavy artillery and repairs to rifling, but gives a much greater range than that of artillery. When the impulse of the catapulting is spent, the projectile flies on under its own power, maintaining direction, height and balance by the gyrostatic pilot, operated either by exhaust of the engine or compressed air.

Normally designed for about double the range of long range artillery and for use in very large numbers, 40 lb. units can be made for much less than the cost of firing an artillery shell.



NAVY "E"

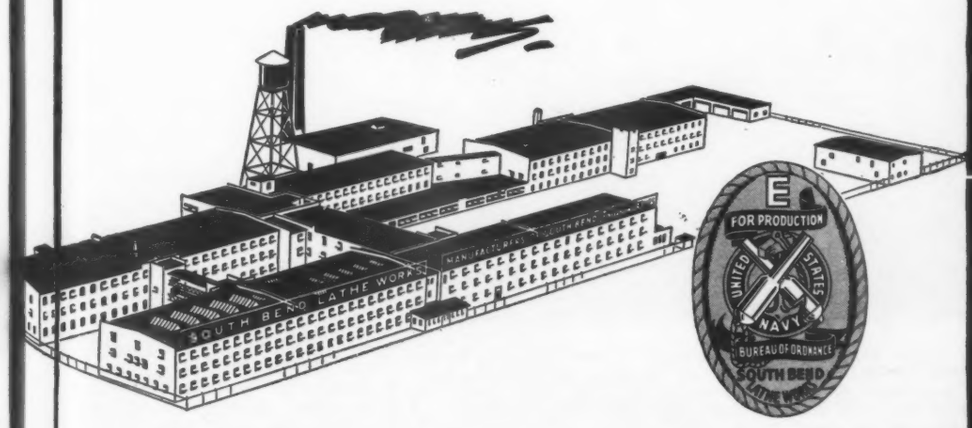
Awarded to

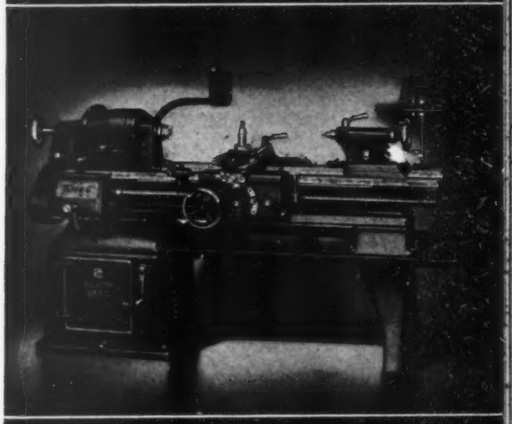
SOUTH BEND LATHE

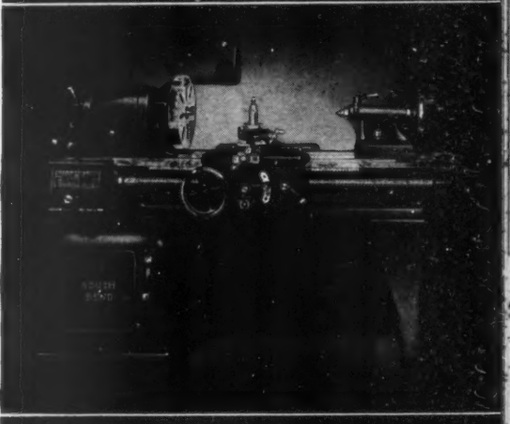
The Navy Ordnance Flag and "E" Pennant have been awarded to the South Bend Lathe Works for outstanding performance in the production of ordnance matériel for the United States Navy.

For years South Bend Lathes have served our Navy. More recently—since Defense demands have called for vastly increased machine tool production—South Bend has been "ahead of schedule" in the production of lathes.

Permission to fly the Navy "E" from our flagstaff and to wear the "E" on our lapels, is an honor. While these emblems serve as recognition for work well done—they also serve as a reminder of the tremendous job that lies ahead. We will do our part to help finish it.







SOUTH BEND LATHE WORKS

754 E. Madison St., South Bend, Ind. *Lathe Builders for 35 Years*

Air Force Expands Over 84 Combat Groups
Air Corps Sets Up New Training Command

Washington (AVIATION Bureau)—To meet the increasing proportion of air action in the total war all over the world, the Army Air Force has again expanded its combat components to some point far beyond the earlier objective of 84 groups. Secretary of War Stimson implied at a press conference that build-up for the 84 groups had been more than doubled.

This Air Force expansion was to be expected, in view of the President's new 185,000-airplane program. We are now aiming at an AAF manpower of 2,000,000, and a large share of the Army's new recruitment will go to the air arm.

Requirement that Cadets have two years of college training has gone out the window, to make way for thousands of capable men who had been barred. For years, some training authorities have contended that college education had little relation to combat performance in the air.

Meanwhile, to provide the tens of thousands of new pilots, observers, navigators, gunners and bombardiers required, a Flying Training Command has been set up in the Air Corps under the command of Gen. Burton K. Yount, a pioneer in air training. The command will bring all training centers under one unified control. Initially, the Command will embrace the Southeast and Gulf Coast training centers; others will follow.

Power of Words

We reproduce herewith a letter written by a workman of Douglas Aircraft Company to the other men in his department. This letter, published in the Douglas AIR-VIEW, is so typical of the way thousands of American workmen feel about the war emergency that we think it should be passed around for everyone to read. Here it is:

"To: The Boys in Section 3—
Douglas Aircraft Company
12/23/41.

"FROM: J. S. Will, Dept. 89

"SUBJECT: Our Job.

"The entire nation was looking at Guam and Wake Island the last two weeks. In the last three days the Japs have claimed that they were "mopping up" these two islands. Our fellows there were about the same age we are, went to the same schools, believed in the same things that we do. They were out-numbered fifty to one. No one would have been ashamed of them if they had asked for quarter in the face of such odds, but they didn't. They made the Japs "mop them up." I believe the whole country expected them to do it. I know they felt that it was expected of them.

"The entire nation is looking at us, too. They expect us to drive every minute we are in here. Every minute we let up to talk to the fellow on the next bench, to go upstairs for a "railroad rest", to sneak a forbidden cigarette, we are cheating those boys that stayed in there and made the Japs come in for the finish. Most of us have made a start at knowing our jobs, none of us work fast enough, hard enough, or accurate enough.

"Three weeks ago we were working here for money, for future security, or because we liked this kind of work. Today we are working for our own self-respect. We must satisfy ourselves that we are giving all we have. So let's go from here on."

Moffett Blimp Patrol

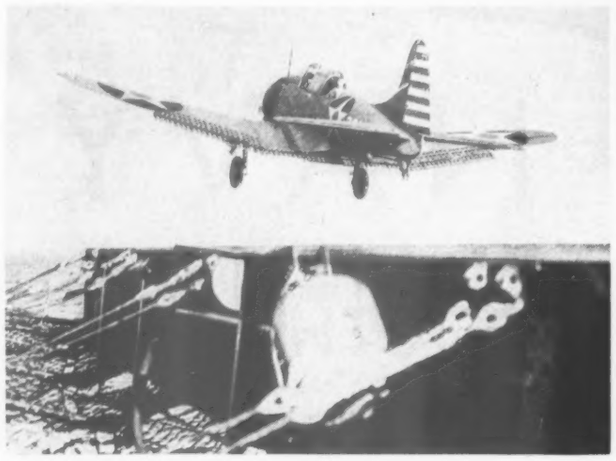
A patrol squadron, using Navy blimps, is established at Moffett Field, 12th Naval District Headquarters announces. The squadron joined Army Air Corps forces using Moffett Field as Headquarters for far western cadet training. By April 16, the Army units will have moved to other bases, leaving the Navy in complete operation of the field, the announcement said.

Rear Admiral Hugh Osternaus, Commander of the Patrol Force of the 12th Naval District, commissioned the squadron. The unit was placed in charge of Lt. Comdr. George F. Watson.

Commander Donald Mackey has been designated prospective commanding officer of the station, from which the blimps will operate in coastal patrol service. The Navy said the blimps, non-rigid, lighter-than-air craft, arrived by special train.

Air Transport Formed

A Naval air transport service is established to provide a fast means of transporting personnel and cargo in connection with Naval operations and will be organized and administered according to existing naval regulations. Operating directly under the chief of naval operations, the present plans call for organization of squadrons which can be expanded as service needs require. They will be placed in service at Norfolk, Va., Kansas City, Kans., and Alameda, Calif., and will not compete with established commercial lines.



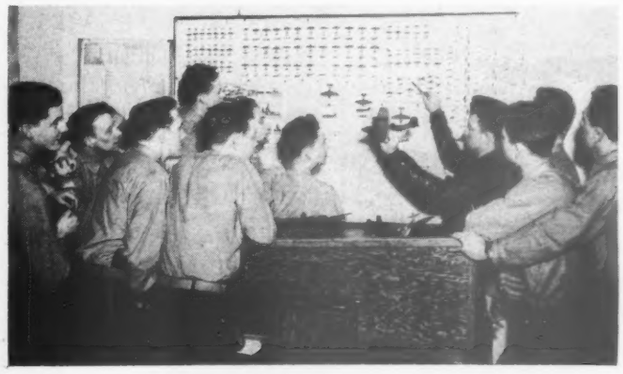
Acme

Going aloft for action in the Pacific Ocean. A Douglas SBD-1 scout bomber, equipped with its distinctive perforated flaps, takes off from an aircraft carrier, as seen from the safety net.

Artillery Air Force

The Field Artillery and the Civil Aeronautics Administration are training pilot-mechanics for light planes for use in artillery observation, in an experimental program started at Fort Sill, Oklahoma.

There are six civilian instructors in flying and ground school subjects, including four selected by the CAA from pilot-training schools, and two who took part in the Army maneuvers last year in connection with the light plane tests. The planes, "putt-putts", will be used as elevated and movable observation stations. Carrying a pilot and observer they will fly above artillery positions from which point the observer will be able to adjust artillery fire.



Model planes aid in training members of the armed forces to recognize various types of aircraft for gun-sighting practice. Navy has called for over 500,000 exact model airplanes to be built by high school students from plans, materials and specifications supplied by government.

Cochran to England

Under the leadership of Miss Jacqueline Cochran, a group of leading American women pilots will go to England to serve with the British Air Transport Auxiliary of the Royal Air Force. The arrangement has the full approval of the U. S. Authorities. Last June Miss Cochran piloted a lockheed Hudson Bomber across the North Atlantic.

BOEING *Flying Fortresses**...

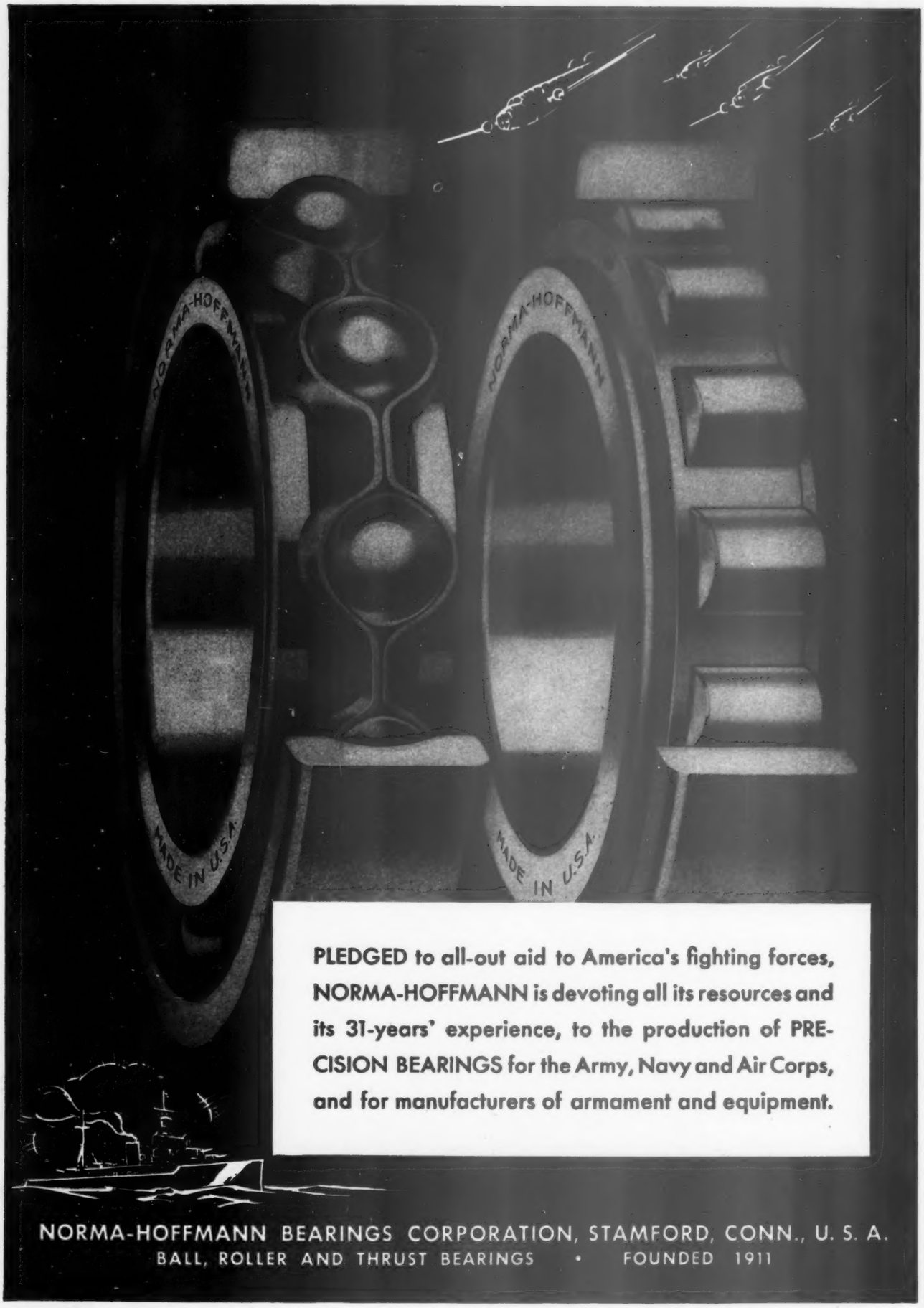
Boeing
AIRPLANE COMPANY
Seattle, Washington
Wichita, Kansas
Vancouver, B. C.

LET'S GO! U.S.A.
KEEP 'EM FLYING!

...FIRST LINE OF ATTACK!

In deadly, secret action high above the far-flung battle grounds of this war are the giant, long-range Boeing bombers of the U. S. Army Air Corps and Great Britain's R. A. F. On vast production lines in this nation, more and more of these formidable, 4-engine Flying Fortresses* are being completed to join the fight to victory.

*Registered Boeing trademark.



PLEDGED to all-out aid to America's fighting forces, NORMA-HOFFMANN is devoting all its resources and its 31-years' experience, to the production of PRECISION BEARINGS for the Army, Navy and Air Corps, and for manufacturers of armament and equipment.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.
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Auto Conversion Authority is in Detroit
Four Point Tool & Technical Plan Set Up

How the great automobile industry is converted to the production of airplanes and munitions, just who does what and how, will be an epic in industrial history—to be read after the war.

To insure full use of this powerful weapon: the Detroit auto community, — Donald Nelson, chairman of the War Production Board, turned it over, not to remote control from Washington, but to his Automotive Council, under auto conversion boss Ernest Kanzler.

Thus Government authority responsible for making war with the auto industry's 1500 plants and 350,000 machine tools is in Detroit. Only a skeleton conversion staff remains in Washington.

Months ago the so-called Reuther plan to produce airplanes in the auto industry was in controversy between labor, the airplane builders, and the Government. This plan called for the pooling of auto plant facilities, the pool to contract for the building of planes, under joint control of management and labor. That is substantially the program now in process of being set up, except that the element of labor control is being left out. Both Nelson and Kanzler are accepting good ideas from labor or anybody, but management is still at the controlls.

To what extent the auto industry will go into finished airplanes is problematical. As everyone knows, Ford is building complete B-24s, and General Motors is under contract to build complete Navy fighters.

Building of aircraft engines by the auto industry will increase until, in a few months, it will be building more of them than the aircraft industry itself. So far, Ford is building the only aircraft engine not designed by aircraft men.

All pulling and hauling is out of order; the Council hopes soon to have complete cooperation. Competition is out. The Council is putting into effect a four-point conversion plan:

1. Retooling existing machinery, providing new or used machine tools for the changed program is a major operation. All tool rooms will participate. Information will be provided by the Automotive Tool & Die Manufacturers Association. Ford can call on General Motors, or vice versa, for tools. Idle machine hours are to be eliminated. Hardest job will be discard of old channels of thought.

2. A machine Tool Listing Service will be conducted by the Automobile Manufacturers Association. All companies will tabulate type, size and location of each tool. Negotiation for sale or lease will be by owners. Outsiders may negotiate also.

3. Contract Distribution Service will handle shopping lists of prime contractors. Lists will describe items wanted and type of equipment necessary to produce it. Subcontractors will report types of machines available, previous experience, present work.

4. Technical Information: product subdivisions are set up for aircraft engines, airframes, ammunition, artillery and so on. They will pool information on the best methods of tooling. Patents are to be freely interchanged.

MAA Elects Officers

Samuel S. Bradley was re-elected Chairman of the Board of the Manufacturers Aircraft Association at the annual meeting. Frank H. Russell will continue as president. John A. Sanborn was re-elected general manager. The Association administers the patent cross-licensing agreement for the airplane industry in the United States.

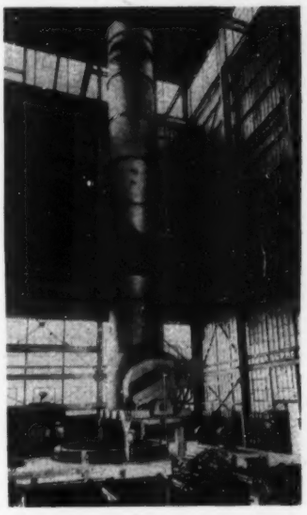
The following vice-presidents were elected: Edgar N. Gott, Consolidated Aircraft Corp., San Diego, Calif.; R. E. Gross, Lockheed Aircraft Corp., Burbank, Calif.; Jos. T. Hartson, the Glenn L. Martin Co., Baltimore, Md.; J. H. Kindelberger, North American Aviation, Inc., Inglewood, Calif.; John M. Rogers, Douglas Aircraft Co. Inc., Santa Monica, Calif.; William E. Valk, Curtiss-Wright Corp., New York; Eugene E. Wilson, United Aircraft Corp., East Hartford, Conn.

In addition, James P. Murray of Boeing Aircraft Co., Seattle, Washington, was made secretary and Clayton J. Brukner, Waco Aircraft Co., Troy, Ohio, was re-elected treasurer.

War Notes from The Factory Front

All-out war has brought radical changes along the aircraft factory front. Here are some pertinent paragraphs from Southern California.

Although the average age of Douglas Aircraft Co. employees is 29 years, a drive has been conducted to find employment for fit men of advanced years but possessing special qualifications. Oldest man in the shop is Ralph O. Hayes, disc grinder operator in Dept. 1, with Tom Berry, 76, a tube bander in Dept. 6 a close second. Other oldsters include George W. Smith, 74, hammer rolling machine operator in Dept. 81, Phillip C. Hertel, 75, carpenter in Dept. 67; John Marcou, 71, disc grinder in Dept. 1; Kennet J. Girdwood, 70 template inspector, Dept. 658, Long Beach plant; and Sam Willis, 68, tube dept., El Segundo plant. All these men, and others of advanced age, are on the regular payroll, at regular wages, and work full hours. They ask no quarter of anyone and are doing their full share towards war production.



Extruded aluminum bars, rods and tubing for fuselages are heat-treated in this 76 ft. Westinghouse resistance furnace at the Reynolds Metals Co., Louisville, Ky. Pieces are heated uniformly to 925 deg. F. without distortion and dropped to a water quench bath in a pit beneath.

Another Douglas defense item, designed to stimulate morale, is the company baby bonus plan. For every child born to a company employee the company awards a $5 defense savings stamp. For twins, triplets, quadruplets, or what have you, the plan is carried through to include a $5 stamp for each child. Also included are flowers for the mother and congratulations to the father. The plan has stimulated interest in and purchase of defense stamps by Douglas employees.

Lockheed - Vega officials stepped forward with a practical helping hand for the widows and mothers of men who were killed in action at Pearl Harbor. Jobs in the Lockheed-Vega organization were offered to all these women who wanted to go to work, and sixty wives and one mother responded, were job tested and put to work helping build bombers and fighters with which to help avenge Pearl Harbor.

Rapidly increasing employment of women by the aircraft plants has brought many special problems. At North American the women showed up for shop work in such a

Aerial camera supports, control fittings and assemblies are among the 306 items of military aircraft equipment being produced at Ternstedt Mfg. Div., Detroit. Here a few of the die-cast aluminum and magnesium alloy parts are being inspected and packed for shipment.

wide variety of slack suits that a standard women's uniform has been adopted. But the women still insist on using their compacts and lip sticks. In fact some of the shops are staging beauty contests among the women workers. More than 2,000 women workers are already on the job in Los Angeles County plants and about 1,000 in San Diego, with the number growing rapidly.

Another unique development, the result of 24 hr. production schedules, is the new "swing shift" early morning broadcasting program inaugurated by station KNX of the CBS chain. Instead of signing off at midnight or 1:00 a.m., as has been customary with most stations, KNX carries right through to 5:00 a.m. with an all-night program of outstanding re-broadcasts of regular daytime shows; late news reports; live programs by famous bands, etc. This has made a hit with the night shift workers and is definitely a morale builder.

Lockheed has also taken a hand at the broadcasting business, staging a series of news broadcasts to factory workers on the late night shift. These broadcasts are put out over the plant loudspeaker system.

Another sidelight on war production is the problem of entertaining the thousands of troops who stand guard around all the aircraft plants. Many spontaneous gestures of hospitality have been shown these soldiers by the factory employees. Douglas employees alone collected a $12,000 hospitality fund and have already presented more than 6,000 bars of candy and an equal number of packages of cigarets to the men on duty. Consolidated Aircraft Corp. employees have likewise arranged for gifts of candies or smokes for the soldiers, and one Consolidated receptionist prepares coffee every night for at least 40 soldiers.

An expansion program to more than double production facilities is under way by Harvey Machine Company, Los Angeles, largest independent manufacturer of aircraft parts in the Southern California area. Added to the Los Angeles plant is a complete new assembly line and a large number of new spot welders built to Harvey's own design.

Ranger Distributors

David A. Marcus, president of Electronic Specialty Company, manufacturers of the Ranger line of aircraft radio equipment, has announced apointment of distributors in the Texas and Florida territories. Rex Bassett, Inc., Municipal Airport, Ft. Lauderdale, Florida, is the new distributor for the State of Florida. And in Texas distribution will be handled by Aircraft Sales Company, Municipal Airport, Ft. Worth, of which "Les" H. Bowman is president. The Ranger line includes two-way interphone equipment as well as lightweight receivers and transmitters.

Yearbook Changes

A revised list of personnel of the Bell Aircraft Corp. is printed herewith, to be substituted for that which appeared in the Directory of Aircraft Manufacturers, page 195, in the February issue.

Bell Aircraft Corporation, Buffalo, N. Y. President and General Manager — Lawrence D. Bell; Asst. to the President—David G. Forman; First Vice-President—Ray P. Whitman; Vice-President in charge of Contracts—Capt. Harry E. Collins; Vice-President and Asst. General Manager—Omer L. Woodson; Secretary and Treasurer—Charles L. Beard; Sales Manager (on military leave)—J. Fred Schoellkopf, IV; Chief Design Engineer—Robert J. Woods; Executive Chief Engineer—Harlan M. Poyer; Works Manager—Lester L. Benson; Purchasing Agent—Vincent J. Dolan; Industrial Relations Director—Vaughn Bell; Advertising Manager—A. T. Hapke; Washington Representative—Frederick R. Neely, 104 W. Bellefonte Ave., Alexandria, Va.

On page 225, of the same issue, in the Directory of Aviation Suppliers, in the list of personnel of *Eclipse Aviation Div., Bendix Aviation Corp.,* Bendix, N. J., the engineer in charge of the hydraulic department should be corrected to read: D. J. Deschamps.

In AVIATION'S Yearbook, Feb., 1942, page 137, the pictures of two of the airplanes in the 1-3 seat section were unfortunately switched in making up the page. Thus, the Call Model A photo appears over the Culver LCA and LSA caption, and the Culver plane over the caption for the Call model.

On page 127 of the same issue, it was erroneously stated that the height of the Armstrong-Whitworth Ensign was 103 ft., which even for the Ensign was exaggerated. The true height is 23 ft. Incidently, while the British publication, the Aeroplane Spotter, gives the Ensign's length as 110 ft., other sources make it 114 ft.

The landing gear of the Ensign is of exceptional length, for the airplane is the high wing type, and passengers are afforded the comparatively rare opportunity of watching the retraction and lowering of a big transport's wheels.

ASSEMBLY LINES . . . By Dorsey Adams

Navy awarded contracts for over $300,000,000 of war material to General Motors, in addition to contracts heretofore placed with the automotive industry. Award of these contracts fits in with the policy of the War and Navy Departments to utilize quickly as possible the trained employees and facilities of the automotive industry in war production.

Ryan Aeronautical Company develops a new seaplane model of the latest type primary military trainer, flight tests of which have been completed under the direction of Joe Rust. Designated ST3-S, the trainer differs from the Air Corps' latest Ryan PT-22 trainers by substitution of twin floats for the land plane landing gear. Powered with a 160 hp Kinner radial engine, the plane is 22 ft. 5 in. long, has a wing span of 30 ft. 1 in. The fuselage is metal construction with wings fabric covered over wood and metal structure. All seaplane trainers thus far constructed have been exported.

Buick-built aircraft engines were in the test stands as the General Motors car division announced it is in prduction at an accelerating rate. The project, in production for several weeks on parts and subassemblies has achieved productive operations in all plants within eight months from the time construction and equipment was started. Within 200 days from blue-prints to production and 243 days to finished engines was the record, considered by military authorities to be top performance for a production conversion of this scale.

Aeronca Aircraft has defense contracts that will require months to complete, signed with the War Department since January 1, 1942. In addition to building the O-58 Observation Ship for the U. S. Army, the Company builds the Defender Trainer and Super Chief models now used by CPTP and the CAP.

Fleet Aircraft Limited's factory in Canada will soon be turning out a minimum of five Fairchild trainers a day, W. J. Sanderson, president and general manager, announces. The factory will be operated at capacity for at least another two years.

North American's B-25 medium bomber has been named the "Mitchell" in honor of the man who forsaw America's destiny in the air two decades ago. Gen. Arnold, who approved the name, recently described the B-25 as "a husky 14-ton baby which is a hard-hitting member of our striking power."

100 Canadian aircraft workers, to take a three-month course at Los Angeles Technical Aircraft Institute, at a joint expense of their employers and the Labor Department's war emergency training program, have gone to California for special courses in production methods. Twelve Canadian manufacturing and overhaul plants are contributing, and home-study courses are provided for 1,000 other Canadian workers to extend over eight months.

Percentage of scrap to raw material handled by Douglas Aircraft decreased 12 percent from 1940 and 40 percent from 1939, despite a large step-up in production which ordinarily would be accompanied by increased waste. Quantities of items such as rivets, screws, machine tailings, dural odds and ends, foundry dross, fittings, imperfect parts and accessories, formerly lost as scrap, were salvaged, sorted, reprocessed and put to use.

Beech Aircraft adopts a profit-sharing plan by which workers receive half of the total net profits. First payments to employees for November and December amounted to an average of 17.89 percent of the total individual worker's earnings for the two months.

Canada has concluded a license agreement with the Fairchild Engine and Airplane Corporation under which it will manufacture an undisclosed number of Fairchild Trainers powered by the Fairchild-built Ranger in-line air-cooled engines, to be known as the "Fairchild Cornell". More powerful and more completely equipped than the Fairchild low-wing cantilever monoplane extensively used in U.S. Air Corps primary training under the designation PT-19, the Canadian version of the plane has been designated by our Air Corps as the PT-26.

JACOBS AIRCRAFT ENGINE CO.

POTTSTOWN, PENNSYLVANIA, U.S.A. · · · · · · · · CABLES: JAECO

AVIATION ABROAD

Canadian News

BY JAMES MONTAGNES

An order for more than 1,000 Curtiss navy dive bombers (SB2C-1 Helldiver) was announced at Ottawa by the Department of Munitions and Supply for the Canadian Car & Foundry Co. late in January. The order will occupy the full facilities of the Fort William plant of the company, and the greater part of its Montreal plant, until late in 1944. The contract, totalling $60,000,000, calls for 12 months of sustained peak production. It is expected that the first plane will be completed early in 1943. Preliminary tooling is already underway. There is to be no stoppage on Hurricane production at the Fort William plant while it is being prepared for the dive bombers.

In the annual statement of Canadian Car & Foundry mention was made that construction of Hurricane fighter aircraft at the Fort William plant had hardly reached the maximum when delays were incurred through changes made necessary by developments in the type of combat on the front lines.

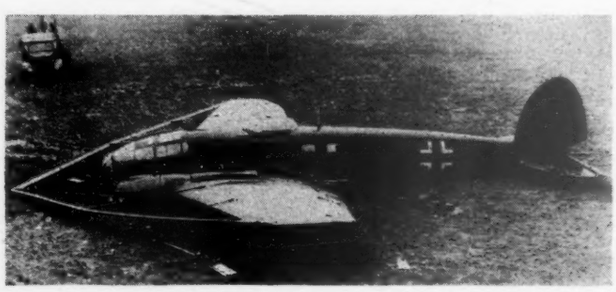
Contracts for other aircraft and components have moved at close to scheduled rates and the Amherst, Nova Scotia, plant produced the first Canadian-made Avro Anson twin-engined trainer last August. The company also is manufacturing propellers at a Montreal plant for both the Canadian and United States governments. Profits for the company in the fiscal year ending Sept. 30, 1941, were announced as the largest since 1930, amounting to $2,356,435 as compared with $1,443,949 in the previous year. The company is at present the largest in the Canadian aviation industry

Canadian airplane manufacturers will produce only eight types of planes when orders for the present assortment of 15 types are finished. The eight planes to be made are the Fairchild Freshman, to be built by Fleet Aircraft Corp.; the Harvard trainer to be built by Noorduyn Aviation; the Canadian Avro Anson by Federal Aircraft; the Bristol Bolingbroke, Canadian version of the twin-engined Bristol Blenheim, by Fairchild Aircraft; the PBY Catalina flying boat by Boeing Aircraft and Canadian Vickers; the Lancaster by National Steel Car and Canadian Car & Foundry; a secret plane being built by de Havilland Aircraft; and the Curtiss dive bomber to be built by Canadian Car & Foundry Co.

Canadian revenue passenger air traffic during the first nine months of 1941 jumped to 135,922 compared to 105,015 in 1940, according to a report issued late in January, 1942, by the Dominion Bureau of Statistics, Ottawa. Revenue paying freight traffic also increased in this period from 9,333,151 lb. in 1940 to 11,037,528 lb. in 1941. Air mail jumped to 2,406,420 lb. as compared to 1,961,716 lb. during the first nine months. Average passenger journey was 300 miles.

Correction

An unfortunate but entirely unintended error occurred in the December issue of Aviation, in the article, "Keep 'Em Flying Abroad" by Arthur L. Fornoff, Service Manager of Bell Aircraft Corporation. On page 188 of that issue, it was stated, incorrectly, that a type of fastener, other than the Camloc Fastener, was used in attaching cowling plates. The specific reference should have read: "The great number of inspection plates, as well as the cowling plates, attached by **Camloc Fasteners** and other fasteners, also aids during the servicing of the Airacobra."

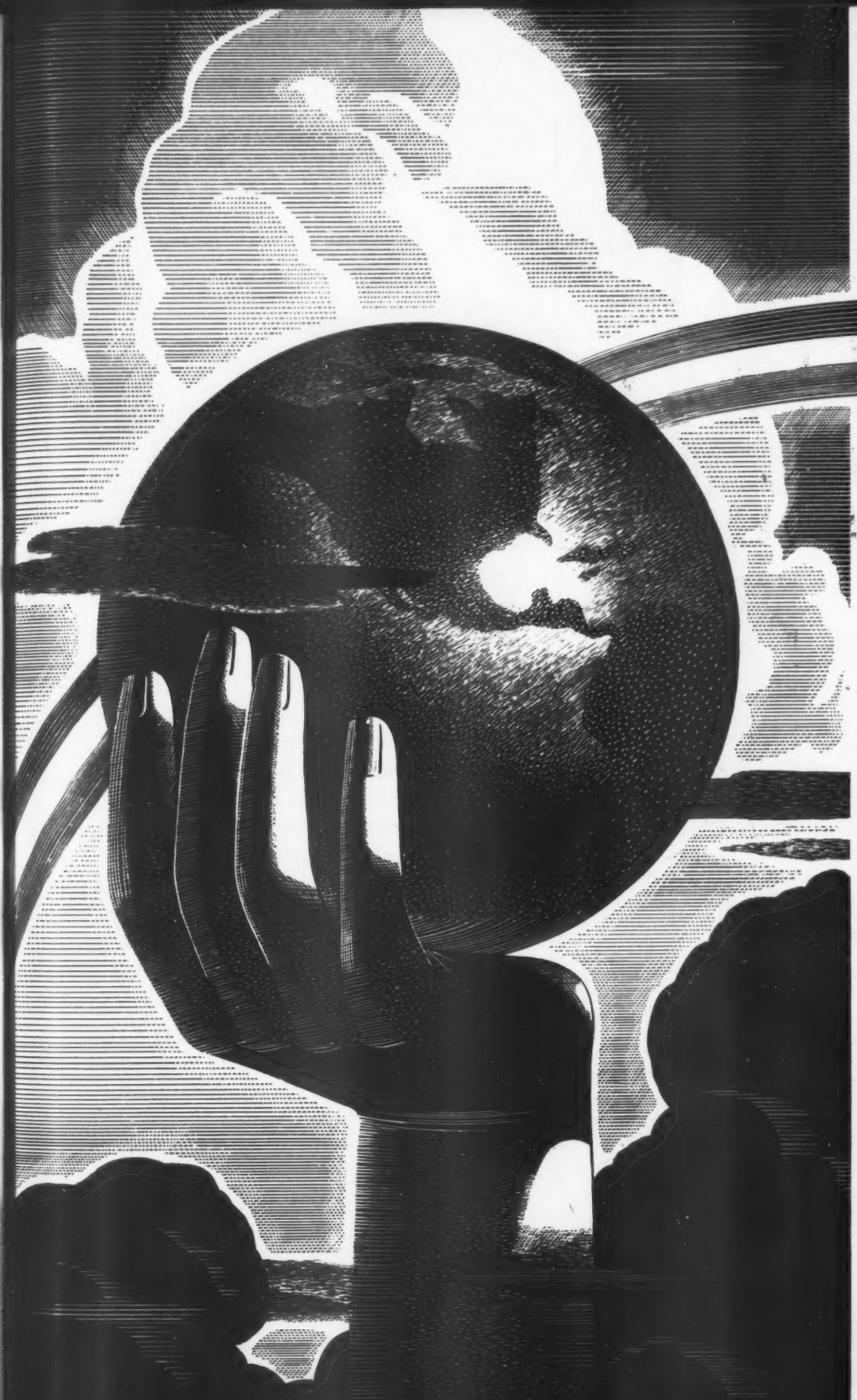


Aerial "cowcatcher" on this crashed Heinkel 111k shows Nazi attempt to cope with the balloon barrage cables over England.

ON SCHEDULE . . . by "Vista"

Important news seems to be brewing in France, both occupied and unoccupied, and just where it is all leading to is anyone's guess. Little facts, published here and there, all join to form a more or less complete picture of civil aviation among the once enthusiastic but somewhat lackadaisical European pioneers. In the October issue attention was called to the fact that Air France, which was then reportedly about to acquire a new name (Réseau Aérien Français) besides undergoing wholesale reorganization, with German "aid" of course, was making vigorous attempts to restart its foreign lines, especially in South America. Thanks mainly to the activities of the American Committee active down there, and the constant expansion and competition of both Pan American and Pan American Grace, nothing came of these plans. According to the latest reports, Air France has more or less given up the battle in South America, and is now looking around for buyers for its flying equipment, spare parts, fuel and ground stations, which are spread pretty well around. But in France matters appear far—around the middle of last September a new French commercial aviation law was drawn up, which, amongst other rights, gave the government the right to cancel all existing air service franchises three months after the law took effect. That the news of the "new French airline group, Réseau Aérien Français" around that time was apparently a mistake, even if true, is now quite clear, because at that time no one was supposed to know anything about the plans which were in the offing. These plans finally led up to events around the middle of December, which effectively wrote "Finis" across the records of three well-known French airlines, to wit: Air France, Air France Trans-atlantique, and Aéromaritime. The latter company was to establish African coastal services, apparently in direct competition with Air Afrique, which had been providing general service to all French African possessions with Sikorsky S-43's. The method of dispatch was gloriously simple—invoking the three months clause, the government simply cancelled all contracts with these companies, without leaving any apparent loopholes for reconsideration.

The previous news of the formation of the R.A.F. (for Réseau Aérien Français), in which undoubtedly the old companies will take their places, should prevent anyone from being lulled into the belief that French commercial air services can be forgotten for the time being. The simple fact that nothing in France can be accomplished without German permission, combined with a few other little items, should focus American attention more than ever on these developments. First of all, the present management of Air France, spread out among three or four towns in unoccupied France, never maintained more than casual contact with the occupied zone, where the main part of their shops, and, after all, their original main-offices were located. Now suddenly Jean Brun, well known in New York as Air France's last American representative, and well acquainted with American plans, has been placed at the head of a new and large office of Air France in Paris. Mr. Brun, by the way, was more or less exiled to New York due to disagreements with Pierre Cot, former French Air Minister, who made a vain attempt to bring at least a semblance of unity and adequate equipment to the French Air Force and airlines. Mr. Cot is now in this part of the world.



Our Rendezvous with DESTINY

WITH the world the battleground for freedom, we face the gravest crisis in our history. Because this is *total war*, certainty of our victory is possible only as we become soldiers all. There's a soldier's job to do on the farm, in the mine, at the factory, yes, and in the home. America united is America invincible.

The order of the day for soldiers of Democracy in and out of uniform is, "Fight with *everything* you have for *everything* you hold dear." Only in that great day of final victory will we have kept our rendezvous with destiny and be able to "look forward and move forward to a future worthy of men with peace in our hearts."

We of the vast army of aircraft production soldiers again pledge our total effort to build in overwhelming volume the wings with which fighting America will triumph in justice. Whoever you are, wherever you are — in your own way, you can do no less.

Donald W. Douglas

PRESIDENT, DOUGLAS AIRCRAFT CO.

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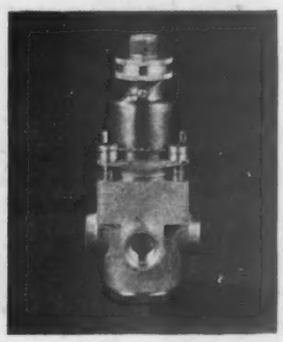
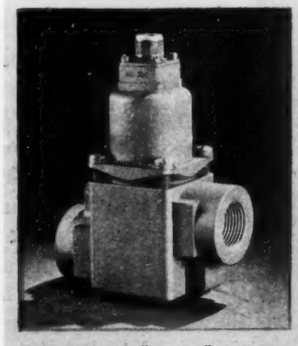
Simplify complicated hydraulic systems with General Controls Series AV Electric Valves. Their light weight saves dead weight; compact design saves space; remote control saves piping and tubing. Valve operation is unaffected by vibration, mounting position or acceleration, i.e. substantial increases in "g."



Type AV-11; 3-way hydraulic control valve; 1500 lbs. or higher.



Type AV-6; ¾" and 1" full flow valve for gasoline cross feed.

Extremely fast operation—to less than 1/100 of a second—is practical. Continuous duty or intermittent duty, or other electrical variations are available to meet every requirement. For the positive control of gasoline, oil, hydraulic fluids, anti-icing fluids, cabin heater fuel, air or other gases, the AV Series includes single, normally open or closed, three-way or four-way electric valves. Pressures handled range from zero to 1500 lbs. or more. For special applications, valves will be developed to specifications.

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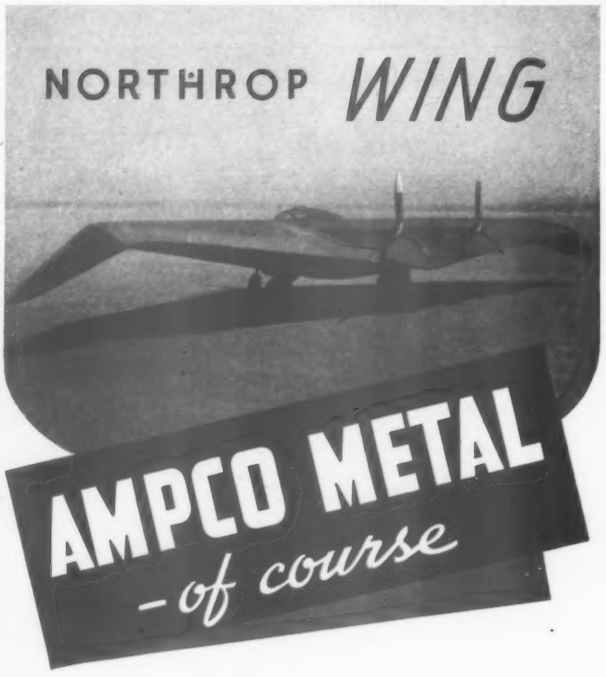


The new mystery ship—the Northrop Wing—recently revealed as America's latest contribution to aviation progress, contains parts of Ampco-made bronze. Northrop engineers, when building the flying model of the wing, used Ampco alloys, as they had proved themselves in other Northrop ships.

Once again an outstanding aircraft development depends upon Ampco for vital frictional parts, which will stubbornly resist wear, impact, and shock.

Over thirty-three different makes of airplanes are Ampco-equipped—an impressive array of evidence that Ampco is meeting the needs of the aircraft industry. Engines, propellers, retractable landing gear—these and a host of other equipment find Ampco giving ample service life.

The reason why is given in a new bulletin, "Ampco Metal in Aircraft," sent free on request.

AMPCO METAL, INC.

Department A-3 Milwaukee, Wisconsin

RUSSELL R. VOUGHT, who with his late brother, Chance Vought, developed the Corsair, is now v. p. and West Coast gen. mgr. of United Aircraft Service Corp. (subs. of United Aircraft Corp.).

Election of three new vice-presidents of North American Aviation, Inc., is announced by J. H. Kindelberger, president. They are ROBERT A. LAMBETH (l.), treasurer, named vice-president and treasurer; RAYMOND H. RICE (c.), chief engineer, now vice-president in charge of engineering; J. S. SMITHSON (r.), general manufacturing manager, now vice-president in charge of manufacturing. All have had long aviation experience and have been associated with North American Aviation since 1936, 1935, and 1934 respectively. Lambeth's early aviation experience was with Western Air Express and Transcontinental & Western Air.

Appointment of FRED F. HERZER as vice-pres. in charge of production, is announced by H. Ray Ellinwood, president of Adel Precision Products Corp. Herzer was asst. chief engineer at Vultee.

Veteran United Air Lines pilot, Capt. H. P. LITTLE, is named coordinator of airways traffic control for the Air Transport Assn., and will coordinate flight practices and procedures.

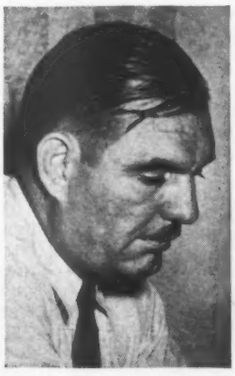
His work on hydrodynamic stability of flying boats and seaplanes won for ERNEST G. STOUT the annual Lawrence Sperry Award to a young man, for notable contribution to the aeronautical sciences.

Taylorcraft Aviation Corporation's founder, C. G. TAYLOR, has resigned as consultant to the company, to broaden his field of activity in the aviation industry. He organized the company in 1930.

CYRIL CHAPPELLET, with Lockheed since 1932, has been elected its vice-president, retaining his post as secretary. He is also secretary of Vega and president of Lockheed Air Terminal.

MAJOR GEN. JAMES E. CHANEY'S post of commanding general of the U. S. Army Forces in the British Isles is the first such post in our history. He has been serving in London since early 1941.

GEORGE A. RIX, heretofore chief hydraulics engineer for Hughes Aircraft Co., has joined the sales engineering department of Aircraft Accessories Corp., producers of hydraulic equipment.



RICHARD B. BOUTELLE, gen. mgr. of Fairchild Aircraft Div., is elected a vice-pres. and director of Fairchild Engine & Airplane Corp., assuming all the titles and duties of the late F. A. GALLIGAN.

Readers of PAUL H. WILKINSON'S articles in AVIATION will be interested to know that he is in charge of the Army and Navy Aircraft Section, Div. of Contract Distribution of OPM for N. Y.

HUGH R. PERRY, (above), for past 12 years, sales mgr. of Waco Aircraft, becomes vice-pres. and a director. A. L. RIGGS, asst. sales manager, succeeds him, and will handle subcontracts.

The new department of aeronautical engineering at Princeton will be headed by DANIEL SAYRE, former associate editor of AVIATION. Sayre was on the faculty of MIT, and recently with CAB.

Airlines' Place in War Effort Seems Secure
Priority System Leaves Seats for Regulars
Operators Perform Important Missions

Washington (AVIATION Bureau)—Establishment by the War Department of a priority system on airline seats actually was nothing but a formalization of practices existing during recent months. But the announcement caused the public to assume that space was hard to get, and in some regions traffic declined as a result.

To recoup this loss some of the lines, notably United and American, bought full page newspaper space for advertisements carrying their story.

United told how its plans for equipment, maintenance and personnel would assure continued adequate service for regular travelers and quoted the statement of Gen. Donald Conolly, Military Director of Civil Aviation, who is in charge of priorities: "Priorities . . . will not interfere to any large extent with the travel of the general public . . . the percentage of . . . priority passengers will be very small." American also quoted him, and assured its public it wouldn't have to stand in line.

Harold Crary, traffic vice president of United, told AVIATION he believed the airlines would be operating 25% more seats next summer than in 1941, and they expect to take care of normal traffic. He said there are 1800 seats a day flown out of Chicago, for example, and a large proportion of them are being used by business men on government work. Of these 1800 seats, at the time he made the statement, only about 65 percent were occupied on the average, which is a normal traffiic load.

On behalf of United, Mr. Crary said the line is operating more schedules than last January, at a load factor of 64 percent. He said United's inventories of all parts and replacements have been kept above normal.

The formalizing of seat priorities is regarded here as recognition by the Administration that the airway system must be kept intact as is for best service in the war effort. Air Transport Association officials are pleased with the system: it takes away from the operators the disagreeable job of exercising preferences among their customers.

Here's how it works: the eligible list includes White House personnel; Service pilots traveling on ferry command duty; Service and Allied military missions directed to travel by air; Army, Navy equipment ordered by air; persons whose duties are essential to the war effort, who are specifically directed to travel by air.

Adjoining General Conolly's office is the Army's airline priority headquarters. It receives all requests for priority on seats. Callers are asked if they are authorized by Army, Navy, WPB or other agency to fly. If they have such authority, they are asked if they've tried to make reservations, and if not, are advised to do so. If that fails, they get a priority. Unauthorized persons are told to do the best they can on their own.

An adjoining office of the Air Transport Association takes over official priorities, and orders the seats on the lines, but it receives no calls direct from applicants.

Another branch of Gen. Conolly's office is all set for any emergency that might call the great armada of airline planes into concentration on one spot. In such cases the equipment will remain under its own management, flown by its own pilots. Several special missions have already been performed, with utmost secrecy.

Pending Route Applications

With one exception all applications before the Civil Aeronautics Board for new route certificates and extensions are being held in abeyance, due to shortage of equipment and pilots. No more hearings are held unless requested by Army or Navy or State Department for strategic reasons.

The one exception is American Airlines' application for runs to Mexico City from Los Angeles and El Paso, Tex. This project has been approved by the war departments of both Mexico and the United States.

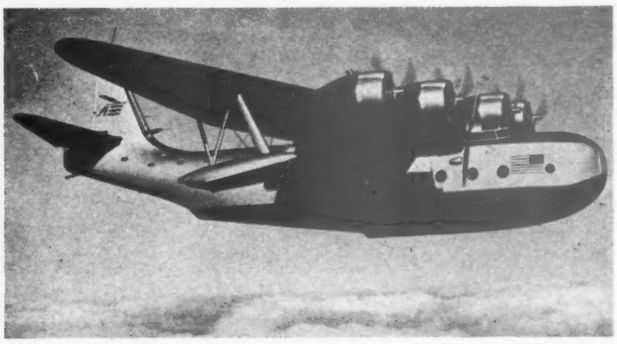
A score of other applications are pending, and will not be acted upon until the war ends or Army or Navy requests it. TWA for Los Angeles-San Francisco via Fresno and Oakland, and for inclusion of Phoenix on route 2; Pan American for Los Angeles to Mexico City; Seaboard Airways for Boston-Miami-New Orleans; TWA for Newark-Boston; Penn-Central for Norfolk Va., to Detroit; Northeast Airlines for Bangor-Newfoundland; Northwest Airlines for Minneapolis-Fairbanks, Alaska; and several others. Pan American's application for New Orleans-Guatemala-Panama was approved by the examiner only, and Export's application for the same route was disapproved by the examiner only. Pan American's new application for New York-Foynes-Marsailles was approved. The C.A.B. granted a temporary certificate to American Export authorizing operation between New York and Foynes, Ireland.

Safety Award Made

The National Safety Council announces its Aviation Safety Awards to airlines having no fatal accidents to passengers or crew in 1941.

Group A (100,000,000 or more annual passenger miles) was won by United Air Lines. Its planes flew 312,207,740 passenger miles since the last fatal accident on December 4, 1940. Group B (10,000,000 to 100,000,000 miles) was awarded to Braniff Airways, Inc., who flew 109,603,136 passenger miles since its last fatality on March 26, 1939. Group C (10,000,000 miles or less) went to Mid-Continent Airlines, Inc. for flying 31,907,096 passenger miles since its last fatal accident on November 15, 1934.

Eleven other airlines which also had no fatal accidents in 1941, were awarded certificates of safe operation.



Called the Excalibur, Vought-Sikorsky's big 4-engine flying boat takes to the skies on its maiden flight. It is first of the three being built for American Export Airlines which has been granted a temporary certificate for operation between New York and Foynes, Ireland.

P. O. Reports Airmail

At the close of the 1941 fiscal year upward of 41,400 miles of domestic air mail routes were in operation, according to the annual report of the Post Office Department. This figure compares with the total of 37,943 miles in operation at the close of the previous year.

Mail miles flown for the year reached a total of 74,297,154 as compared with previous year's 59,177,525. Total cost of the air mail for the year was given as approximately $20,000,000 as compared with $18,855,306 for the preceding year.

Increase of the amount of mail handled by air mail during the year also showed large gains, the increase being estimated at approximately 19 per cent in volume.

The report also shows that 13 new domestic routes were established during the year, reaching a total of 53 new cities with direct air mail.

Whether or not air mail accounted for part of the $26,963,681 accrued deficit is not shown. Domestic air mail postage brought .029¢ per dollar revenue and foreign, .011¢.

CAB Reports Accident of Northwest at Fargo

Failure of the aircraft to respond to application of full power after it had gone into a partial stall at Moorehead, Minn., Oct. 30, last, is given by CAB in its formal report as the probable cause of the Northwest Airlines crash which killed twelve passengers and two of the ship's crew.

Contributing causes listed by CAB: accumulation of ice on the wings and other surfaces, increasing the stalling speed and drag of the airplane; failure of the captain, owing to his having lost confidence in his air-speed indicators, to realize his close approach to a stalled condition; action of the captain in attempting a landing at Fargo with known icing conditions and critical ceiling conditions, instead of proceeding to an available alternate landing; failure of the dispatcher to

recognize the seriousness of weather conditions in the vicinity of Fargo, and to direct the pilot to proceed to his alternate.

The Board says concerning effect of application of full power under conditions existing at the place and time of the crash, "it is apparently indispensable to depress the nose of the airplane in order to reduce the rate of descent even after the application of full power."

CAB repeats the warning against the practice of letting down "to take a look" when weather conditions are officially reported to be less than the prescribed minimum."

P.A.A. War Operations Take Shape

It has been a source of considerable satisfaction to many that the Pan American Airways System turned so easily and smoothly from quasi-peace time operations to full war time flying. Many of the actual facts are of course covered by wartime censorship, but the general picture shapes up as follows:

The Trans-Atlantic service is operating like clock-work, but without the hour and minute hands because schedules are secret, and will soon again be flown via San Juan, Port of Spain, Belem, Natal and Bolama, since permission has been received for this service from the C.A.B., with certain restrictions on local traffic as far as this hemisphere is concerned.

The Trans-Pacific service per se does no longer exist for the time being; instead, there is a new and longer line, running over 16,000 miles eastward from New York to China. This new route, which takes only one week, is flown by flying boats from New York to Rangoon, and from there with the DC-3's of the CNAC, its Chinese subsidiary, to Chungking. At the same time service is provided by the Netherlands airlines—at least these connections existed at the time of writing—with the Netherlands East Indies and Australia. Some disorganization is expected from the fact that Australia has decided to halt all empire air mail routes, perhaps partly due to the loss of one of the flying boats in the Timor Sea with a loss of 13 lives. Only Pan American Airways has the equipment and, more important, the personnel to fly a route from Rangoon to Australia, avoiding the danger zones around the Indies.

NA Abolishes AM, PM

Adopting the practice of many European countries and the U. S. Army air corps, Northwest Airlines, Inc., has announced it has gone on the 24-hour clock. Instead of 8 a.m. and 8 p.m. NWA schedules will read simply 8 o'clock or 20 o'clock, etc.

Announcement of this change has been made by George Bardner, NWA vice president in charge of operations. Hours before noon will stand as at present, but after 12 noon, will be counted from 13 to 24, eliminating the a.m. or p.m. designations.

TRANSPORT DOINGS

United Air Lines, at Chicago, with the ddition of a wing which more than doubles its previous size, completes the largest airline headquarters building in the world. The building, located across Cicero Avenue from the Chicago municipal airport, houses approximately 500 United personnel. A nation-wide campaign for sale of defense bonds and collection of American Red Cross money among its employees has been launched by UAL under direction of B. B. Gragg, director of sales; who is working with district traffic managers of the company in their respective territories covering 42 cities in 16 states and one Canadian province. The Company is operating 12 daily round trips New York - Chicago, 7 from coast to coast, 12 San Francisco-Los Angeles, 4 the length of the Pacific Coast and additional inter-city schedules. Observing that businessmen flying through Chicago want to make stops for conferences, United has invited representatives of business and industrial organizations of 100 leading firms in New York, Philadelphia, Cleveland, and Chicago to use the conference rooms and facilities, which include stenographic, telephone and wire services, in its general headquarters building.

Braniff Airways announced that 13 ticket offices in midwestern and southwestern cities served by the line will sell defense stamps to the traveling public. Important amendments to the Braniff contract has been signed including agreement on an increased wage scale which brings pay boosts to all classifications of mechanics, inspectors, crew chiefs, cleaners, stockroom and ground service employees.

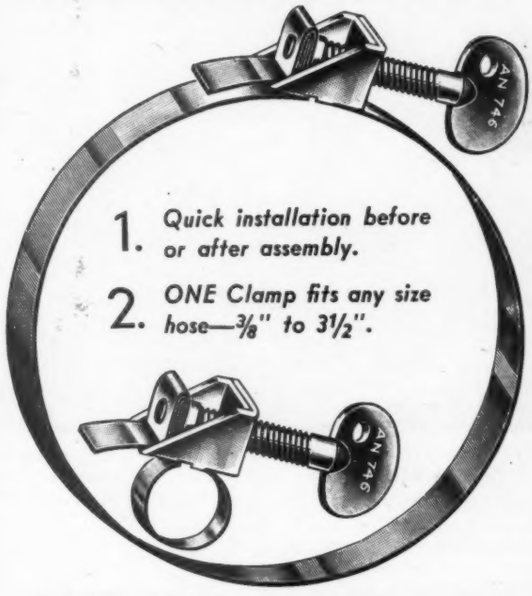
Trans-Canada opens a personnel training school at Winnipeg, to replace members of its staff called for military service, for women aged 21 to 28 years, and male applicants exempt from military service. Company is reserving two seats each day for American, British, Canadian and other officials traveling between Washington and Ottawa.

Penn-Central posts notices advising passengers to pack their cameras or check them with the hostesses and instructs crew members to discontinue taking aerial views from the cockpit.

National Exchange Club, first nation-wide organization to actively sponsor model aviation movement, is ready to sponsor building model aircraft for airplane identification training of armed forces and CAP.

WAR DEMANDS THAT WE SAVE TIME!

YOU SAVE TIME BY USING . . . ACTUS HOSE CLAMPS



1. *Quick installation before or after assembly.*
2. *ONE Clamp fits any size hose—3/8" to 3 1/2".*

ACTUS Hi-Pressure Stainless Steel Hose Clamps are now used by the U. S. Navy and Coast Guard, Canadian Government, British Air Ministry and many leading aircraft and engine manufacturers.

•

ACTUS Hose Clamps are lighter, stronger, and take up less space than any clamp made. Let us show you how ACTUS will expedite production schedules.

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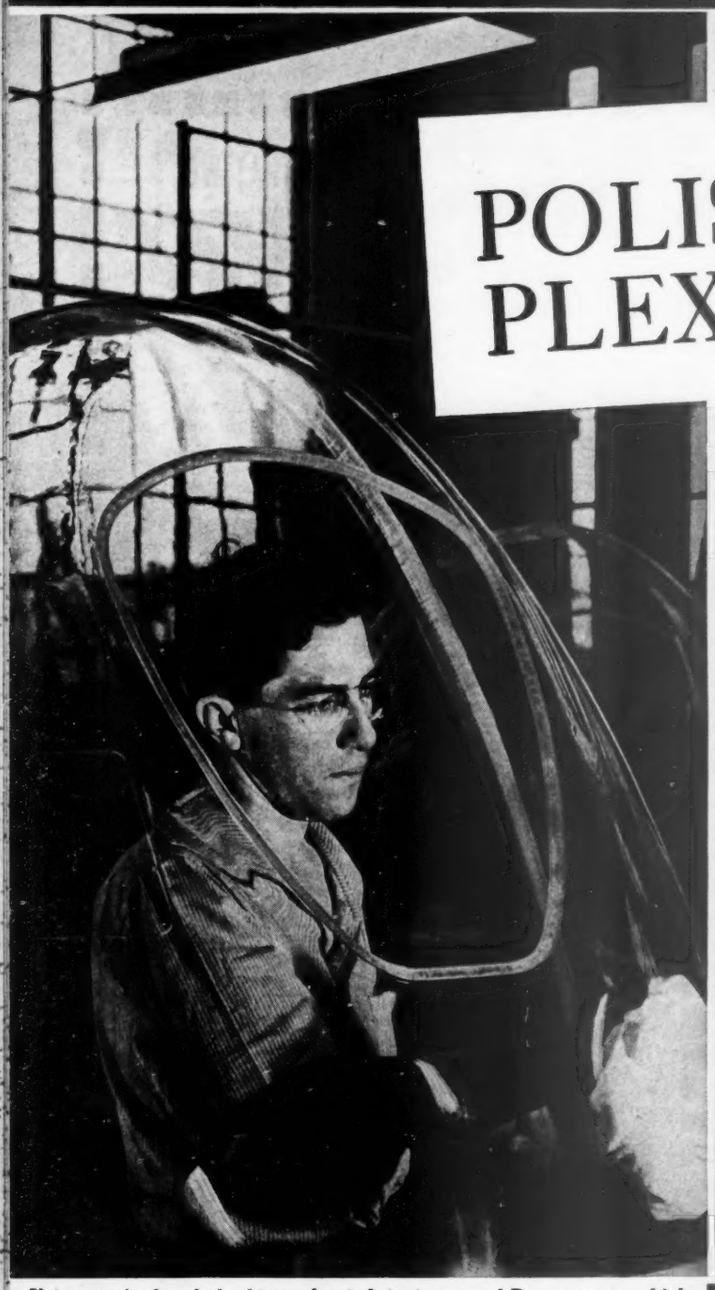
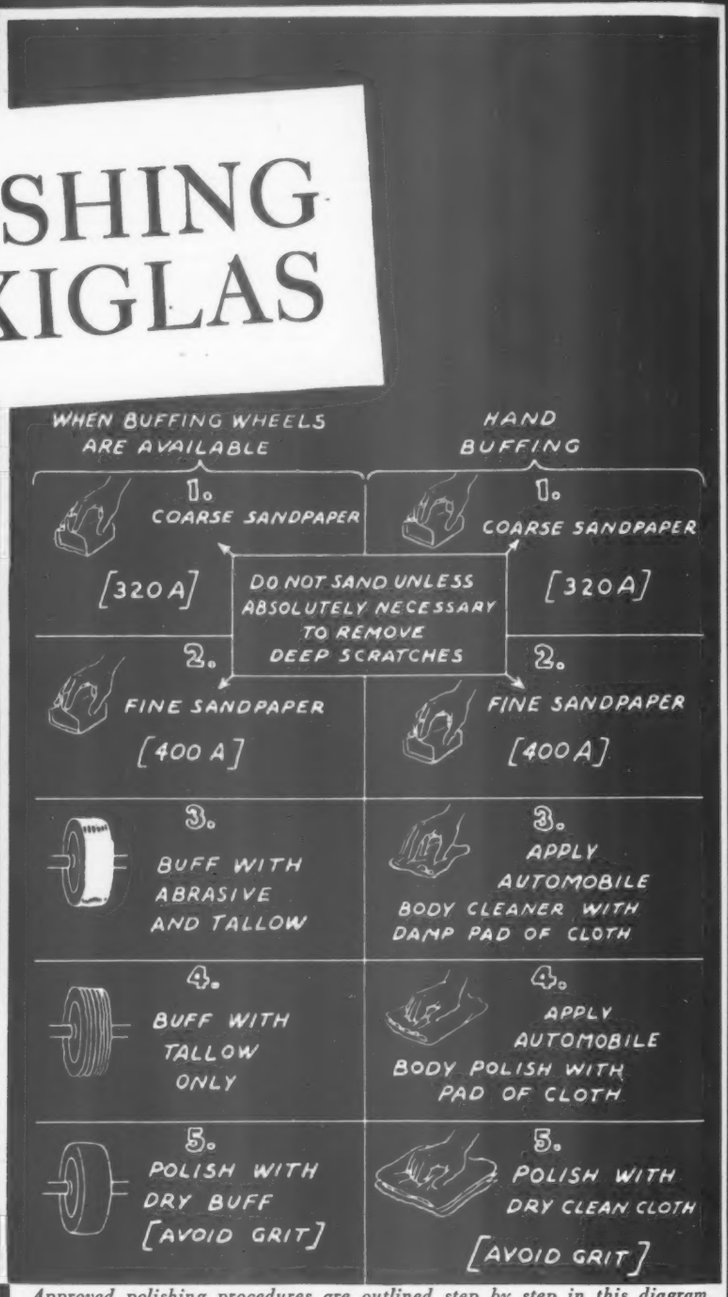
POLISHING PLEXIGLAS




WHEN BUFFING WHEELS ARE AVAILABLE
HAND BUFFING
1. COARSE SANDPAPER [320 A]
1. COARSE SANDPAPER [320 A]
DO NOT SAND UNLESS ABSOLUTELY NECESSARY TO REMOVE DEEP SCRATCHES
2. FINE SANDPAPER [400 A]
2. FINE SANDPAPER [400 A]
3. BUFF WITH ABRASIVE AND TALLOW
3. APPLY AUTOMOBILE BODY CLEANER WITH DAMP PAD OF CLOTH
4. BUFF WITH TALLOW ONLY
4. APPLY AUTOMOBILE BODY POLISH WITH PAD OF CLOTH
5. POLISH WITH DRY BUFF [AVOID GRIT]
5. POLISH WITH DRY CLEAN CLOTH [AVOID GRIT]

• *Using a soft, dry cloth, this worker is bringing waxed* PLEXIGLAS *to a high gloss. Army and Navy bombers, PT boats, and other military materiel depend for their efficiency upon permanently transparent* PLEXIGLAS *sections.*

Approved polishing procedures are outlined step by step in this diagram, typical of many in the new PLEXIGLAS *Fabricating Manual. A copy of this important new work will be gladly sent on request.*

THERE are wrong ways and right ways to polish PLEXIGLAS to bring this crystal-clear plastic to its highest transparency. Knowing all the right ways can help you speed production and reduce rejects in the manufacture of the PLEXIGLAS units needed for defense.

A new PLEXIGLAS Fabricating Manual just issued describes in detail the best methods not only for polishing PLEXIGLAS but for other fabrication operations.

WRITE TODAY FOR A COPY OF THIS NEW MANUAL

PLEXIGLAS and CRYSTALITE are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

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WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Leather and Textile Specialties and Finishes . . Enzymes . . Crystal-Clear Acrylic Plastics . . Synthetic Insecticides . . Fungicides . . and other Industrial Chemicals

Liberty Aircraft Products Corp. is the latest aircraft firm to undertake new financing through issuance of new stock. This parts and equipment maker has filed a registration statement with the S.E.C. covering 60,000 shares of cumulative convertible preferred stock and 120,000 shares of common stock. The common shares will be reserved for exercise of conversion rights from the preferred. Last fall Liberty purchased 51 percent control of the Auto Car Co. which is manufacturing scout cars and heavy trucks and tractors for the government.

Square D Co. shareholders met on Feb. 16 to approve an increase in the company's authorized common stock from 500,000 shares to 600,000 shares and also to vote a reduction in the 5 percent preferred from 30,000 shares to 19,000 shares. F. W. Magin, president, announced there was no immediate need for additional capital but because of the larger inventories, receivables and taxes incident to a constantly increasing volume of business the time might come when new capital would be needed through the sale of a limited amount of common stock.

Cessna Aircraft common stock in the amount of 21,445 shares were recently offered to the public by New York brokers at $11.50 a share. The offering was part of 71,446 shares owned jointly by Dwane L. Wallace and Dwight S. Wallace, the company's two principal stockholders, and were offered for their account.

United Aircraft Corp. common shareholders subscribed to 60 percent of the 265,669 shares of preferred stock recently offered at $100 a share. The unsubscribed portion was sold to the public by the underwriters. United has stabilized net profits at pre-emergency levels and paid out the larger share of earnings in stockholders' dividends, according to Eugene E. Wilson, president of the company. In spite of rapidly increasing sales, the percentage of net profit to sales has declined. In discussing war business recently, Mr. Wilson said that during the war profits appear large but in the transition period to a peacetime business they disappear and there is no real profit in the long run.

Vultee Aircraft, according to a company's statement, is continuing the development of products suitable for commercial demands and is producing commercial planes on a limited scale. On Dec. 9, 1941 Vultee had a $7,500,000 promissory note due Mar. 31, 1943 and a $4,200,000 installment promissory note payable in equal installments Mar. 1, 1942 to Feb. 28, 1947. The agreement with respect to both of these notes provides that no dividends shall be paid on Vultee stock and that the company will not redeem or otherwise acquire or retire any of its stock. However, the agreement was waived in regard to dividends on Vultee's new preferred stock which was issued to finance in part the recent acquisition of control of Consolidated Aircraft.

By RAYMOND L. HOADLEY

WAR PROFITEERING charges filled the air last month but there was little mention made of the aircraft industry in this respect after the Naval Affairs Committee of the House of Representatives admitted an error in charging a big profit to Brewster Aeronautical Corp. on a contract in which the company had actually shown a loss. The current sentiment among congressmen appears to be that there will be no further profit restrictions but that excess profits levies will be stepped up sharply again this year. Meanwhile indications that the war production program will call for further expenditures of nearly one billion dollars for new aircraft plants, tool and equipment accentuates the fear that the aircraft industry will have plant capacity far in excess of all anticipated requirements after the war. Therefore it is reassuring for stockholders to note that most companies set aside millions of dollars from their 1941 earnings for future contingencies. Trade circles expect that a new wave of union demands for higher wages must be faced early this spring on the basis of higher living costs. These factors of taxes, costs and concern over post-war deflation may account for the fact that aircraft stocks have been selling recently on an average of only about four times current earning power instead of the usual ten times earnings stock-market yardstick of yesteryear.

Wall Street has been buzzing with reports that Republic Aircraft Corp. was about to merge, first with Curtiss-Wright Corp. and then with United Aircraft Corp. However, Republic spokesmen say the rumors are without foundation. Any negotiations the company may have with other companies are more likely to center around the licensing of one or more other companies to make Republic's fast new pursuit plane, just as the aircraft engine companies and the bomber makers have licensed others to make their engines and planes.

When the government clamped on formal airline passenger priorities the public misunderstood the order with the result that civilian traffic fell off abruptly. The airlines promptly started a newspaper campaign stating that they still would be able to handle most of their civilian traffic and space reservations again reached normal proportions.

If the airlines receive the transport planes that have been allotted to them for 1942 there seems no reason to doubt that passenger traffic throughout the year will achieve new high records. And now that Curtiss-Wright is coming into production on its Army transport plane the military pressure for commercial transport planes should lessen. The rubber tire shortage shortly will put a premium on all types of transportation and another year may bring travel priorities for the railroads as well as the airlines.

Bendix Aviation's aircraft parts and accessories sales five years ago amounted to only 20 percent of the company's total volume, the remainder going to the automotive industry. In 1941—a banner year for the motor industry—Bendix reported sales of automotive equipment accounted for only 15 percent of total volume, although they were 30 percent higher than in the previous year.

An analysis of a representative group of aviation stocks held in the portfolio of Aviation Group Shares shows that nine aircraft manufacturing stocks recently were selling on an average of around 3.9 times their estimated 1941 earnings while three airline stocks were selling at about 10.2 times estimated 1941 profits, according to Hare's Ltd. The aircraft stocks showed a profit margin on sales of 7.6 percent in 1941 and 12.3 percent in 1940 while the airline issues showed profit margins of 9.4 and 9.7 percent in 1941 and 1940, respectively.

The practice of setting up post-war reserves is becoming common among the major aircraft companies. Curtiss-Wright, Sperry and United Aircraft announced some time ago that such charges would be deducted from 1941 earnings and it is expected that forthcoming annual reports of other companies will reveal similar reserves. Bell Aircraft, for example, has deducted a $1,200,000 reserve for contingencies out of total earnings, after taxes, of $3,170,645.

Hayes Manufacturing Co. has unfilled and pending orders for aircraft sub-assemblies amounting to $12,200,000, as against $6,500,000 a year ago, Rensselaer W. Clark, president, told stockholders at the annual meeting. Approximately 1,500 workers are now employed, compared with 547 last March and 25 percent more will be added during the present year. The general outlook

Current Earnings Reports

Company	Period	Net Profits		Profits Per Share		Sales	
		1941	1940	1941	1940	1941	1940
Air Associates	12 mos. Sept. 30	$456,555	$409,265	$3.35	$3.50	$7,410,746	$4,065,112
Aircraft Accessories	6 " Oct. 31	85,089	.....	....	....	.....	.....
Beech Aircraft	3 " Dec. 31	193,502	89,493	0.48	0.22	.....	.....
Bell Aircraft	12 " " "	1,970,645	284,745	5.55	1.14	46,414,444	5,188,001
Bendix	3 " " "	3,113,328	2,835,321	1.47	1.35	.....	.....
Hayes Mfg. Co	3 " " "	71,235	L 39,220	0.08	....	.....	.....
Piper Aircraft	12 " Sept. 30	210,883	157,823	1.44	1.06	4,679,507	3,230,086
Vultee Aircraft	12 " Nov. 30	3,100,735	374,457	2.95	0.86	34,057,207	5,606,410

L — Loss

for the concern is encouraging, Mr. Clark said.

Douglas Aircraft has salvaged literally millions of dollars as the result of strenuous efforts to conserve former waste material and scrap. In 1941 the amount of scrap to raw material handled decreased 12 percent from 1940 and 40 percent from 1939 despite the big acceleration of output which ordinarily would be accompanied by increased waste.

The first two major companies to issue their 1941 annual reports show an increase in sales volume that is probably indicative of the way deliveries of the entire industry skyrocketed last year. Bell Aircraft's sales showed a nine fold jump, totalling $46,414,000, as against $5,188,000 in 1940 while Vultee's volume rose sevenfold to a new high of $34,057,000, as compared with $5,606,000 in 1940.

HERE AND THERE . . . Much information ordinarily given in the annual reports of the aircraft manufacturing companies, such as backlogs of unfilled orders, is now prohibited by censorship regulations . . . Besides pursuit airplanes, **Bell Aircraft** is making ordnance of its own design and manufacture . . . George M. Williams, president of Russell Mfg. Co. of Middletown, Conn. has been appointed assistant to Tom M. Girdler, chairman of the Vultee-Consolidated aircraft companies, while I. M. Laddon has been named executive vice president and general manager of **Consolidated** . . . Charles W. Baker and Thomas P. Durell have been elected directors of **Hayes Mfg. Co.** . . . **Grumman Aircraft Engineering Corp.** accounted for around three-quarters of the business of Liberty Aircraft Products during the 1941 fiscal year . . . **American Airlines** is the first air transport company in the world to carry one million or more passengers in any one calendar year . . . Stock of **Transcontinental & Western Air, Inc.**, has been listed on the Chicago Stock Exchange . . . annual reports of several investment trusts have been issued showing that **Aviation Capital, Inc.** finished the year with liquidating value of $16.40 a share, against $19.18 the previous year while **Air Investors** liquidating value stood at $1.25 per common share, against $1.80 and **Aeronautical Securities** had net assets of $6.75, against $8.47 the previous year.

Kellett Autogiro Corp. had sales of $1,786,000 in 1941, as against $739,823 during 1940, according to R. G. Kellett, vice president. Open orders in Jan. 1, 1942 stood at $4,010,000, against $1,857,000 the previous year. Monthly shipments are on an increasing scale, particularly since the declaration of war.

Murray Corp. of America is building up its aircraft parts business so rapidly that by spring earnings from such production should fully offset the adverse effect of automobile curtailment, according to Detroit reports. Murray's aircraft contracts are on a cost plus 6 or 7 percent basis. Current orders include inner wing sections, nacelles and other parts from Boeing, Douglas and other aircraft manufacturers.

North American Report

Net profits of North American Aviation, Inc., for the nine months ended last Sept. 30th, totalled $6,075,954, compared with $7,090,336 for the 12 months period ending Dec. 31, 1940. The company changed its fiscal year from the calendar year to the 12 months ending Sept. 30, as of last September. Sales for the nine months were $60,865,687 against but $36,862,514 in the full 1940 calendar year. Gross profit was $19,656,796 as compared with $11,340,887. However, the gain in gross profit was more than offset by increases in certain charges, notably Federal income taxes. The balance sheet as of Sept. 30th showed current assets of $80,876,554, with current liabilities of $67,994,018. As of Dec. 31, 1940, current assets were $51,013,414, and current liabilities were $41,385,227.

New Kinner Order

A new War Department contract for $8,000,000 worth of training plane engines boosts the backlog of Kinner Motors, Inc., to approximately $11,500,000. Earl Herring, vice president and general manager, has announced a substantial expansion of production facilities. Kinner is the largest engine builder on the Pacific Coast and claims the plant's output of horsepower per man is one of the highest in the country.

Timm Earnings Up

Net earning of Timm Aircraft Corp. for the 10 months ended Oct. 31, 1941, end of the Company's new fiscal year, were $156,662 after all charges. This compares with a net loss of $37,146 for the calendar year ended Dec. 31, 1940. Sales for the ten month period were $915,544, against $121,654 for the full year of 1940. Bulk of the sales were metal parts manufactured under sub-contract to major airplane builders, but production is now under way on the Timm aeromold trainer.

The new Canadian airplane and engine overhaul industry which has been built up since the start of the war is expected to be a $100,000,000 industry in 1942. In 1941 the various companies in the industry did work amounting to $25,000,000. The plants of this new industry, spread from Halifax to Vancouver, are financed mainly by government money amounting to $13,000,000 plus $1,000,000 of private capital. There are 22 plants which do airframe overhaul, 14 which do engine overhaul, five which do both airframe and engine overhaul, five which overhaul airscrews, eight overhaul instruments, six repair electrical spares and parts, 10 battery overhaul plants, and four tire repair and overhaul factories. The factories are not all under civilian management. Some of them are being operated by the Royal Canadian Air Force.

Raw Materials

NEW SPECIFICATIONS for tire manufacturers which are designed to save 20,000 tons of crude rubber a year have been adopted by the War Production Board which will call for less consumption of crude rubber in all types of tires except those used on airplanes.

Meanwhile the reassuring word comes from Canada that the Dominion is prepared to take care of all the war production of Canada and Great Britain in the next two years and at the same time furnish 750,000,000 pounds of this vital aircraft material to the United States. Less cheering are the results of a government survey of this country's resources of bauxite or aluminum ore. It is estimated that these domestic ores will be exhausted in less than six years if foreign imports are stopped and the present rate of consumption is maintained. The W.P.B. estimates that armament bauxite requirements will reach the staggering figure of nearly three million tons annually by July.

Nine new aluminum plants are now under construction and are expected to begin production at the annual rate of 600,000,000 pounds by the end of 1942. When added to the present annual output of 800,000,000 pounds a year, the United States bids fair to have an output of 1,400,000,000 pounds early in 1943. In the meantime the W.P.B. has imposed stricter controls over the white metal by prohibiting the further manufacture of several civilian products which have received material supplies from the inventory bins of several aluminum processors. Also under study are plans for the further expansion of aluminum production by building new facilities. Buick, as part of the aluminum program, is building a $10,000,000 foundry to supply plane engine castings with production scheduled to start next summer.

On the other hand the government has awarded a contract to Matheison Alkali Works for a magnesium plant which will cost $22,500,000 and have a capacity to produce 36,000,000 pounds of this lightest of all metals. The capacity of this one new plant alone will be larger than the nation's 30.000,000 pound output in 1941, and also will be somewhat greater than Germany's accredited magnesium production at the outbreak of the war.

Coming Events

Mar. 2–6 American Society for Test-Materials, Spring Meeting, Hotel Cleveland, Cleveland, Ohio.

Mar. 12–13 Society of Automotive Engineers, Aeronautic Meeting, at Hotel New Yorker, New York, N. Y.

Mar. 23–25 American Society of Mechanical Engineers, Spring Meeting, Houston, Texas.

April 23–25 Women's National Aeronautical Association, Annual Convention, Hotel Phillips, Kansas City, Mo.

May 1–2 Third New England Aviation Conference, Providence, R. I.

May 31–June 5 Society of Automotive Engineers, Semi-Annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia.

June 8–10 American Society of Mechanical Engineers, Semi-Annual Meeting, Cleveland, Ohio.

June 22–26 American Society for Testing Materials, 45th Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Oct. 12–16 National Metal Congress and Exposition, Detroit, Mich.

FORESIGHT

THE WARREN McARTHUR CORPORATION, designers, engineers and manufacturers of technical seating equipment for many of the leading Military Aircraft manufacturers and the Navy, has long been engaged in research to develop the proper materials for substitution and skillfully designing for their scientific application to the airplane requirements of today. The results will be given to the industry shortly.

WARREN McARTHUR CORPORATION

ONE PARK AVENUE NEW YORK CITY

"J.I.T." Program

A streamlined training program that puts into effect the procedure on "How to instruct a man on the job" has been initiated by the Training within Industry Branch of the War Production Board's Labor Division, and called the "J.I.T." (Job Instructor Training) Program.

Already being given to thousands of supervisors, subforemen, and all who direct the work of others, in more than 800 plants employing in excess of 1,300,000 people, the "J.I.T." Program is specially prepared to help those instructing workers on the job.

The procedure is outlined in Bulletin No. 2-C issued by the War Production Board, Washington, D. C. Four steps in breaking in the worker are explained; the first being to prepare the worker to receive the instruction, the second to present the operation, third, to try out his performance, and fourth, to put him on his own but to check frequently for incorrect or unnecessary moves.

The ten-hour program is compact, carefully planned, and practical.

U. S. Trains S. A. Pilots

Training of South American pilots and mechanics in the United States is the most enthusiastic division of the inter-American goodwill program, according to the State Department. The students are of exceptionally high caliber.

The bulk of the 526 scholarship winners are now in training at 16 CAA supervised schools; 15 have arrived at Randolph Field for the Army Air Corps course, excepting military subjects. Quotas call for 200 to be trained as pilots at 13 CAA contract schools, 19 as aeronautical engineers, 87 as instructor mechanics and 120 as service mechanics at three technical schools, and 100 to take a non-military Army flight course.

New Course for Women

Supplementing numerous courses for women workers now offered in commercial aircraft schools of the Southern California area, a tuition-free course in "aircraft engineering drawing" is being offered for women by the University of California at the Los Angeles campus. The course is designed to fit women for employment as detail draftsmen, and requires twelve weeks of full-time attendance, eight hours per day and five days a week. Pre-requisite for the course is satisfactory completion of two years of college or junior college work, with studies in mathematics, sciences, and mechanical drawing preferred. All women taking the course are required to signify their intention of accepting defense work upon satisfactory completion of the training.

Pilots Get 90 Days

In a regulation issued by the Civil Aeronautics Board, pilots' certificates due to expire between January 28 and April 28, 1942, will be automatically extended ninety days and will not require endorsement during that time.

CAB Studies TWA Crash

Investigation of the Transcontinental and Western Airlines crash on a mountain near Las Vegas, Nev., January 16, killing 22 persons, has resulted in close study by CAB of more stringent rules for night flying by commercial planes.

CAB officials said that evidence at the investigation indicated that some airline pilots have been neglecting use of navigational aids provided by the government for night flying.

Larry Fritz, vice president of TWA told the hearing at Los Angeles the ship was flying eight or ten miles north of its charted course, and added that "if the ship had been but a short distance to one side or the other it would have cleared the mountain."

Both Fritz and government weather officials testified that flying conditions were good. This was TWA's first accident since January 23, 1941.

"E" Flag for Roebling

Commander Warren A. Shaw presented the Navy Bureau of Ordnance Flag and the Navy "E" Pennant, highest service award of the Navy, to Mr. William A. Anderson, president of the John A. Roebling's Sons Co., and Navy "E" buttons to the employees, for distinguishing itself in the production of vital Naval ordnance materials above and beyond the call of duty.

Commander Shaw tossed a finger ring made from a German incendiary bomb into one of the open hearth steel furnances in the Roebling Company's New Jersey plant; the melt of steel into which it went will be used in the manufacture of aircraft control cords and cables for the armament program.

Air Mail Rate For Armed Forces

A new air mail rate of six cents per half ounce on personal and official mail of members of the armed forces of the U. S. stationed outside the continental limits of the nation has been announced. All mail written by or addressed to any member of the Army, Navy or Marine Corps who is stationed outside the limits of the United States where U. S. mail service is in operation comes under the new Post Office order. In the case of personal mail, the rank or rating of the individual must appear either in the address or in the return address. The regular Alaska rate of 6c. per ounce remains in effect, though the expression "via clipper" cannot be used. Previous rates included: Porto Rico, 10c. half ounce; Hawaii, 20c. half ounce; Philippines, 40c. half ounce; Canal Zone, 15c. half ounce; and South American bases, 30c. half ounce.

Mechanics Earn While They Learn

In order to meet the demand for aircraft mechanics needed to service Army aircraft, a plan has been inaugurated in California, through cooperation between the Army and the State Department of Education, by which persons between 17 and 44 years of age, both men and women, will be trained in classrooms and shop of the Junior Colleges and high schools of the state school system, and will be paid $75 per month while learning. The first classes were scheduled to start Feb. 16th, running six weeks to two months, with other classes forming at two-week intervals.

Another state-wide training scheme is under development through the California Wing of the Civil Air Patrol. Through the initiative of Thomas Wolfe, vice president of Western Air Lines, a director of the Bowlus Sailplane Company, and a member of the Civil Air Patrol, a plan has been developed for supplying gliders in kit form to high school and junior college boys over 15 years of age. Construction of the gliders will be supervised by manual training departments of the schools, thus teaching the fundamentals of airplane design and construction.

Light Planes Exhibit

Light plane models which have been tested for Army and Navy observation and ambulance work were exhibited at the National Sportsmen's Show, Grand Central Palace, New York, February 21—March 1. Aeronca and Piper Cub, Bennett Air Service, Civil Air Patrol, Safair Inc., Seaplane Club of New York, and Union Mutual Agency had exhibitions in the airplane section.

Newly appointed director of the technical division of Embry-Riddle School of Aviation is August W. Throgmorton who swings into his new duties at Miami.

STEADY WINGS FOR THE "Eyes" OF OUR FLEET!

Every flight is an order – every patrol a precaution! The "air-eyes" of our Navy are on the alert! Ten tons of formidable fighting power, geared for instant action – flying safely and surely on steady wings – guard our shores and guide our battle fleet. Controls taut as "fiddle-strings", *responsive, dependable, sure* – Fafnirs are on the job here, *too!*

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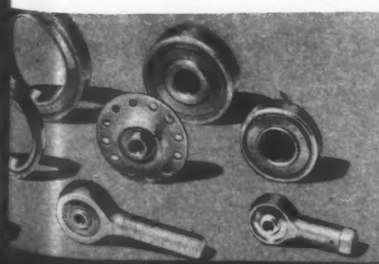

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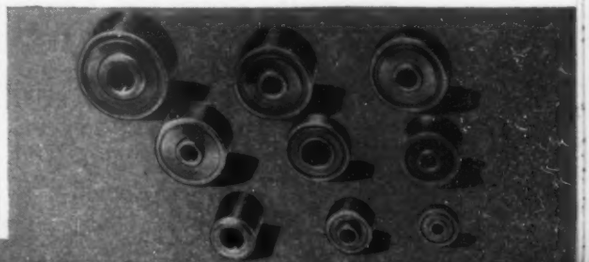

U.S. ARMY flying cadets are well on their way to winning their wings when they get a chance to put this shining new Fleetwings BT-12 through her paces.

She's known by fliers as "in the groove"—aerodynamically stable and easy to fly, sturdy and designed to provide excellent visibility for both instructor and student pilot. *Specifications:* New Fleetwings BT-12, basic trainer, is built principally of *stainless steel* . . . the world's *first* military airplane so constructed. All-welded. Span, 40′; overall length, 29′2″; powered by a 450 h.p. Pratt & Whitney engine.

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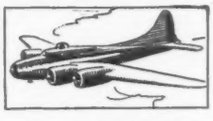

Fleetwings realizes that lives will depend on the successful operation of aircraft hydraulic equipment at widely varying conditions of temperature, pressure, and relative humidity. Therefore, Fleetwings Hydraulic Valves, for instance, must pass rigid proof tests, body pressure tests, cold tests and torque tests. Dimensions are checked to within two one-hundred-thousandths of an inch. These valves can operate all sorts of aircraft equipment . . . from machine gun banks and bomb doors to "Iron Mike," the automatic pilot.

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Recent Books

AIRPLANE LOFTING, by Capt. William Nelson, U. S. Navy (Ret.). Published by McGraw-Hill Book Co., New York, 140 pages, 102 illustrations, indexed, $3.00.

"How a Blueprint of an Airplane is Given Three Dimensions" might have been another title for this book which tells how planes are sculptured into a physical shape from the draftsman's drawings. It is written for anyone studying aircraft building and more particularly for loftsmen, present or future.

It is unique in that it is the first known text on the layoff of airplanes in the mold loft. It should be a help to anyone entering either the loft or the sheet metal fields of airplane construction. It explains, among other things, model-making, plating development, template-making, and photographic reproduction.

Geometrical reviews sufficient for an understanding of the principles concerned are given, as are brief descriptions of the design and construction of airplanes. The book can be used for theoretical study or as a counterpart to the education obtained by actual work in the mold loft.

ELEMENTS OF AERONAUTICS, by Francis Pope and Arthur S. Otis, Ph.D. Published by World Book Co., Yonkers, New York, 660 pages, illustrated, indexed, $3.40.

"Elements of Aeronautics," which represents the combined efforts of two pilots, is intended as a high school text book to prepare students to pass the ground examinations of the Civil Aeronautics Administration.

It explains flying in general, with emphasis on aerodynamics, air navigation, meterology, and the rules and regulations governing flying. It is written in the simplest language and does not assume extensive technical nor mathematical knowledge on the part of the student or instructor. It is supplemented by a teachers' manual, with answers to practice questions.

The basic idea of having a text book on flying for high school students is in response to much recent discussion of the benefits from such classes.

MATHEMATICS FOR THE AVIATION TRADES, by James Naidich. Published by McGraw-Hill Book Co., New York, 267 pages, profusely illustrated, $1.80.

When James Naidich writes a book on the mathematics of the mechanical phases of aviation he ought to know what he is talking about since he is chairman of the department of mathematics of Manhattan High School of Aviation Trades.

He wrote the book not only for his students but for all students in trade and technical schools who intend to become aviation mechanics, and America needs plenty of aviation mechanics from now on out.

The author asserts in his preface that no mechanic can work intelligently from blueprints or use measuring tools without a knowledge of the fundamentals of arithmetic of his trade. Mr. Naidich says that the text is planned to satisfy the demand of instructors and employers that mechanics engaged in precision work have this knowledge. Intended to serve primarily as a foundation of mathematics needed by aviation mechanics, it does not claim to present all of the mathematics needed by aeronautical engineers.

AIRCRAFT SPOTTER, by Lester Ott. Harcourt, Brace & Co., New York, 64 pages, chiefly illustrations, $1.

This paper-covered book purports to teach army and navy people and civilians how to identify military airplanes of the principal warring nations. It devotes 11 pages of illustrations and descriptions to United States planes, 12 to British, 13 to German, 13 to Italian, 2 to Russian, and 1 to Japanese. It has a two-page supplement of some late models. It concludes with 19 photographs of planes which the student can use to test what he has learned. More attention might have been given to Japanese and Russian planes.

AEROPHOTOGRAPHY AND AEROSURVEYING, by James W. Bagley. McGraw-Hill Book Co., New York, 317 pages, indexed, fully illustrated, $3.50.

Intended for anyone wishing to make a careful study of aerophotography and aerosurveying, this text book is written by one well qualified. He is Lt. Col. James W. Bagley, U. S. Army, retired, a lecturer at the Institute of Geographical Exploration, Harvard University.

In his foreword he points out that it is the result of studies carried out through many years and an arrangement of the substance of Harvard lectures. The book obviously would give the student a correct start either in the specific field of photography from the air, or that of extreme refinement and precision in making maps of areas under special investigation, or the more general use of aerial photographs in making exploratory or reconnaisance maps of large areas. Comprehensive in detail, the book follows through from camera equipment to map-making. It explains a technical subject in simple language.

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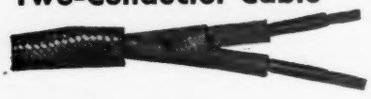

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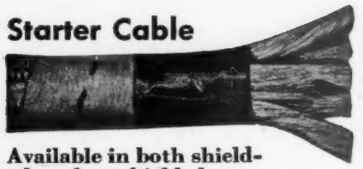

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Brazil Air Expansion

(Continued from page 57)

work that our Air Missions have done. The Naval Mission is the older, its Aviation Section having been at work now for several years. Its present head, Lieutenant-Commander H. B. Temple, says of it: "The Aviation Section has always been an integral part of the Naval Mission and has no separate identity. The mission itself is organized in such a manner that one officer 'specialist' is provided for each naval activity and this organization has been extremely beneficial in that it provided an advisory service, well balanced and capable of coordinating the subordinate activities into the general naval progress. The present aviation member has given assistance to the Brazilian in such matters as conduct of gunnery practice, instrument flight training, squadron organization and training, hangar and school building design, and collaboration in review and publication of technical periodicals, etc."

Lieutenant-Colonel Thomas D. White is the head of the Military Mission, which began its work on August 7, 1940. He has a staff of four officers, three U. S. Army Air Corps technical sergeants and one Brazilian sergeant. This group works independently and has in process or completed these projects: familiarization, instrument and refresher courses on the NA-44s; introduction of the U. S. Army Air Corps Maintenance and Inspection System; revision of traffic regulations and construction of a pyramidal type "TEE" at dos Affonsos; plans for classification of material at depots (United States methods); plans for revision of tabulating pilot time; NACA method of reporting and analyzing flying accidents; primary flying instruction methods of the U. S. Army Air Corps training centers, demonstrated and taught to flying instructors on Fairchild PT-19s and supervision of cadet instruction on the same planes; and finally, installation and application of United States radio maintenance methods. Future projects include courses for unit engineering in U. S. Air Corps maintenance methods and their application to the entire Air Force; revision of the personnel system; technical training with air regiments (dependent on the acquisition of planes) according to United States tactical doctrine; introduction of Air Corps' staff organization for combat units; Air Force maneuvers; joint Air Force establishment of radio navigation aids and an airways' control net.

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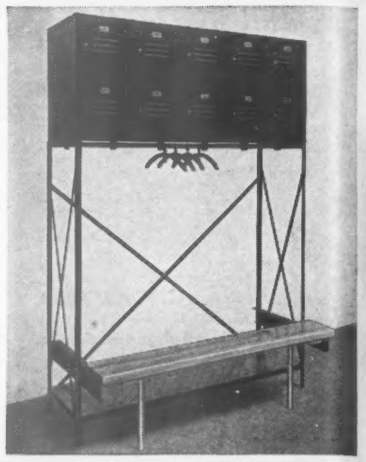

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As makers of America's first and finest light plane, we of Aeronca have, from the start of the National Emergency, adopted an "All Out" policy in concentrating our resources on the government's needs for planes, parts and other essential materials.

Already we have been awarded several exacting commissions for our armed forces — a significant tribute to Aeronca's reputation for skilled craftsmanship and precision engineering. In addition, as our specific contribution to the training of pilots who will play such a basic part in the victory program, we shall continue to build the Aeronca Defender, already acclaimed by instructors as "Trainer of the Year."

But the race against time is vital. Every minute will count. New efficiencies, short cuts, time-eliminating factors must be discovered. This merits recognition over and above the fine "Esprit de Corps" which has made for Aeronca its position of leadership. We have, therefore, established the Aeronca Victory Awards. For every idea, for every plan that any employee creates which will improve a part — or an operation to speed up production — that employee will be rewarded. He will receive the Aeronca's "First and Finest" emblem in gold, plus added compensation.

Aeronca is confident that by its recognition of these contributions to an already highly geared operation, it will do its part in shortening the road to a glorious victory.

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3 Its program is based on the knowledge that comprehensive training in the fundamentals of aeronautics is essential to full success in the specialized branches.

4 Its facilities include 17 shops and laboratories, with aircraft, aircraft engines and instruments, propellers, superchargers, hydraulic landing gear and all other essential modern training equipment.

5 Its prestige has attracted students from every state in the Union and from every continent in the world.

6 Its graduates make good. Ten per cent of United Air Lines personnel have been trained at Boeing School. A recent study shows that Boeing-trained men hold important positions with 52 aeronautical firms, and more than 1,200 former students are gainfully employed in the aviation industry.

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comments I heard from many Brazilian Air Force officers—that these missions of ours have not only done an excellent job technically but that they have personally endeared themselves to Brazilians everywhere. It was said, in fact, that they have done the best "Good Neighbor" work that has been accomplished.

On the civilian side, there are now over 90 aero clubs in Brazil, with a membership in excess of 10,000. Slightly over 1,000 of these are licensed pilots. There is no figure for the number of student pilots, but they are possibly a third of the total membership. The clubs are noteworthy for their intense enthusiasm and determination to develop their country's aviation. They are centers of airmindedness and their influence is radiating rapidly in all directions. The third "Wings Week," which is a nationally organized cavalcade out of Rio, with as many clubs as possible participating, was held this past October. The campaign for planes to equip the clubs, that has been carried on by the Chataubriand string of newspapers, has already resulted in making available about two hundred ships, and more are on the way. In addition, President Vargas has ordered, at government expense, another two hundred H-Ls built for their use

Workers in the Lage plane factory near Rio putting fabric covering on the wings of a Muniz M-9, a military trainer of Brazilian design.

by the Lage factory. Many more are needed, however, and progress will depend on the speed with which they can be obtained.

The civilian pilot training program is conducted through the club organizations, under Air Force supervision. The majority of them do their flying at military fields. The government is trying to standardize the course, but there are still major differences between the clubs. National funds pay for from 50 to 100 percent of the training cost, up to 25 hours and a private brevet. The principal differences between our CPTP course and this is that the Brazilian ground school instruction is given individually and not in classes, and that no student is allowed to solo until he has had almost his full time in an assortment of plane types, ranging from Cubs through Wacos and Ryans, depending on the local club's equipment.

There is one civilian parachute school, started last summer at the Aero Club of Sao Paulo by Charles Aster, one of the foremost jumpers of his country. Aster has more applicants than he can handle, since he is limited to one chute, which he made from parts of several old ones. However, his course is thorough and he is anxious to build it up to a point where it will be possible to train civilian pilots as part of the entire aero club program, for the sake of safety.

In addition, there are three glider clubs. The one in Rio is barely in existence, having only one glider and one pilot; the one in Sao Paulo has been newly resurrected and had over 60 applicants in August last year (1941); but the Varig Aerosport of Porto Alegro, under control of VARIG Airlines, is lusty and well organized.

Women pilots have a hard time. There are 30 with licenses now and a few students, but they cannot receive free government training, nor are they allowed to become instructors as yet. One sixteen year old girl, Elieter Sigueira Walker, ran away from home in Fortaleza, stowed away on a steamer and got to Rio. When the police took her over on arrival, she told them she had come to see the President and ask him to give her a chance to fly. She made so much fuss about it that her story reached Vargas' ears. He sent for her; was impressed by her nerve and determination, and, after settling her with relatives in Rio, sent her to the aero club and is paying for her training. She has already received her private brevet and says she is going to keep on until she is the greatest woman flyer in South America! Her principal idol, next to the President, is Anesia Pinheiro Machado, wife of General Appel Neto, commandant of Galeao, and herself Brazil's outstanding woman pilot.

One instance of the work civilian flying is doing is, I think, a significant demonstration of its value to the country. Three years ago, Colonel Pereira Martins, owner of six large ranches in Matto Grosso, bought the first plane there. Today he has two Stinsons, a fine landing field and hangar and has so encouraged private flying in his state that there are 20 private fields on other ranches. During the rainy season, the roads become impassable, the railroad is frequently unable to run and only the planes can get through.

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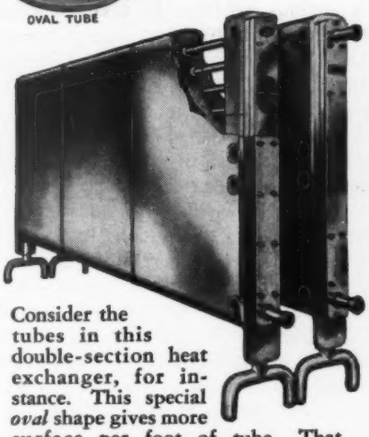

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In the commercial picture, Panair do Brazil is making the most rapid progress. VASP and Condor are still getting a considerable amount of business in the south and VARIG is strong in Rio Grande do Sul. But Condor has been losing ground steadily in the north and west, where anti-German feeling is the strongest and its gas contracts ended with the end of 1941. From now on, it will have to buy on a month by month basis and even this will probably be made as difficult as possible. VASP is in a serious position in several ways, particularly in the matter of equipment. Panair has been given all the recent plums, including the three extensions to Ascunsion, Corumba and Tabatinga this past year. It is also on the upgrade in revenue, with a steady increase in both passenger and cargo business. It needs more planes, however, to handle this increase and needs them soon. In spite of this, its service is the best in the country, although the secret competition that Condor develops through off the record special baggage allowances, passes to influential officials and other sharp trade practices, and the fact that both it and VASP will fly in weather Panair refuses to take chances with, make for difficulty.

With Pan-American Airways assistance, Panair is steadily enlarging its pilot and technical staff and installing more and better ground facilities at its airports. It now has 31 well-trained pilots, all native born Brazilians, 17 radio stations in operation and five more nearly ready, and uses the same weather reporting system as PAA. Its routes are divided into four main districts: the Amazon Valley, the State of Minas Geraes (central); and the south and west, with a total mileage of 7,905. PAA's total route mileage in Brazil is 2,863, making a grand total of 10,769, which is considerably in excess of the nearest rival, Condor. But Condor has more planes, even though the war is making delivery of replacements nearly impossible.

From an overall view, Brazilian aviation has a terrific development job ahead. But it is going about that job in an extremely intelligent and far-sighted way. Given the help in technical advice and instruction and the equipment that only the United States can hope to furnish, it will advance with amazing rapidity. The will to do, the desire to learn and the driving need are evident in all parts of the country. Even under present handicaps, it leads South America today. And its success is a vital matter to us here in the United States.

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Light Planes At War

(*Continued from page 141*)

On numerous occasions, pilots continued operations with badly bent landing gears.

One hour and twenty minutes after a grasshopper's landing gear has been smashed in a landing, spare parts and tools had been flown in and the plane was in service again.

When an engine stud blew, a carriage bolt was inserted with regular Army truck repair equipment and the ship flew during the rest of the maneuvers satisfactorily with those repairs.

A broken fuel line was repaired by a cross roads plumber using lead pipe.

Rips in fabric covering were quickly repaired by adhesive tape borrowed from the Medical Corps. For larger tears, regular bed sheets were torn up for effective patching.

While this hasn't yet happened on maneuvers, a light plane pilot who ticked the ends of his propeller on a landing, used his knife to whittle off the broken tips and flew back to his base.

A broken landing gear was quickly and efficiently repaired by a field repair unit of the Quartermaster Corps. No heat-treated landing gear members, common in heavier military craft, complicated the repairs.

Torn cowlings were patched with metal from gasoline tins.

To some these incidents might indicate that the light planes are fragile and not rugged enough for field use. This assumption may seem to be completely false when it is realized that these planes were flown in and out of places where aircraft operation previously never would have been undertaken. On one occasion, just as an example, I operated successfully off a shelving gravel ledge which was half way up a conical shaped hill. The elevation of the spot was 5,500 feet and temperatures ranged up to 115 degrees in the New Mexican desert. Both take-offs and landings called for a semicircular run around this stratum making an outside turn all the way; all this with a load 80 pounds greater than normally allowed for commercial operations. Under such conditions, the landing gear, in particular, and the whole plane, in general, took a terrific heating.

In other cases, particularly in the Carolinas, most of our landings were made in deeply furrowed fields which jarred and jolted the plane severely. In some places, we were operating off football fields, which, of course, are a standard 100 yards long. Short field

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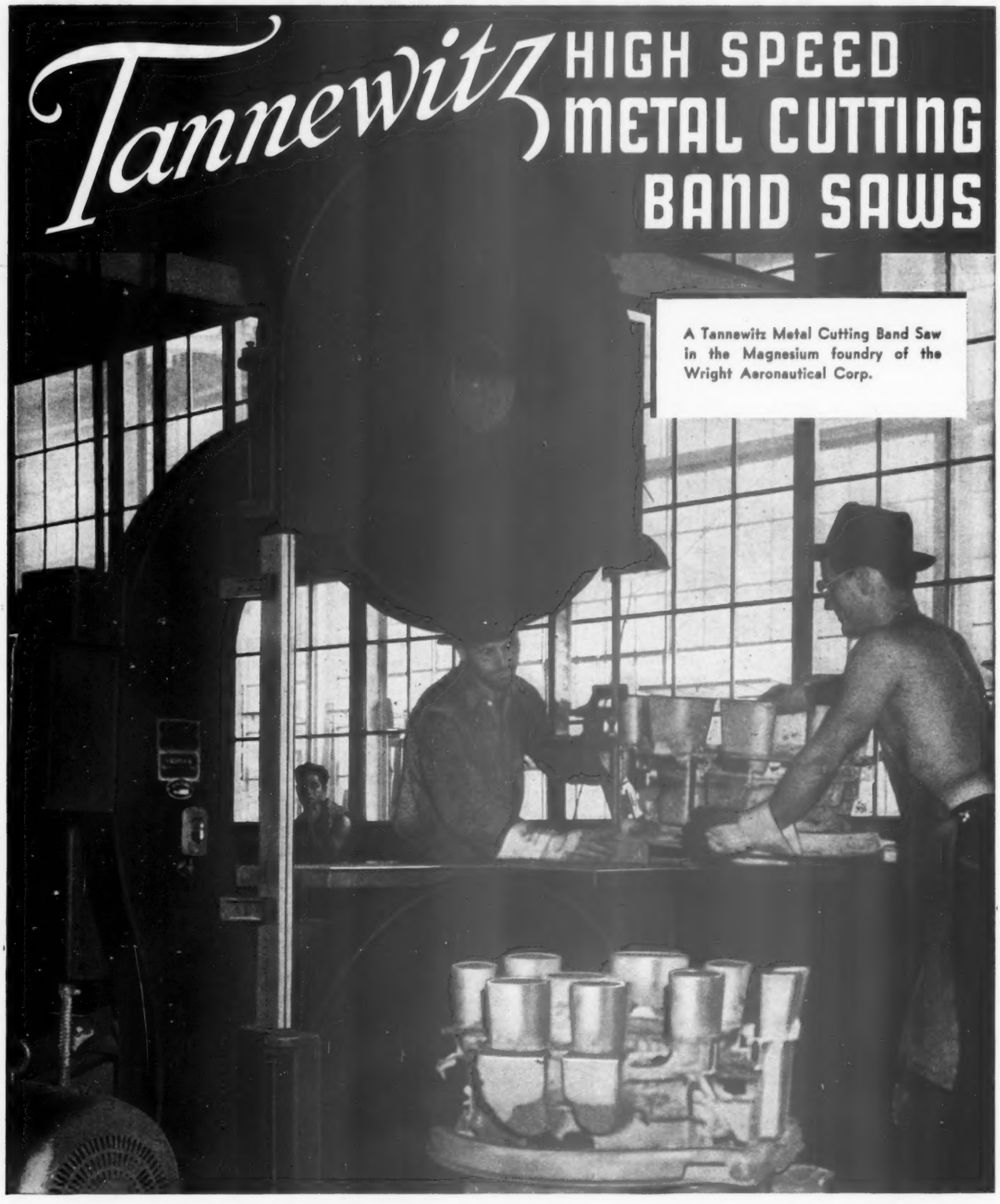

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Fastest, most efficient means of cutting off gates and risers from castings of any metal. Models to handle magnesium and aluminum up to 30 inches thick, 52 inches wide. Larger capacity machines furnished on special order. Variable speed machines available. Write for Metal Cutting Band Saw Bulletin. You'll find the machine that's exactly suited to your needs—one that will repay its cost dozens of times in time and money saved.

THE TANNEWITZ WORKS, GRAND RAPIDS, MICHIGAN

landings like this call for hitting the ground in a terrific mush, bouncing, and applying the brakes full on before the ship hits again. Under all these gruelling conditions the light planes stood up amazingly well.

The repair and maintenance methods used during these simulated war conditions indicate that, except for major wing damage, any grasshopper may be repaired quickly in the field, on the spot. The extremely low speed of the airplanes, with correspondingly low stresses, makes it safe to fly damaged ships, at least back to friendly territory, with a minimum of danger of disintegration in the air.

It is interesting to note that the use originally conceived for the light airplane was almost entirely that of directing artillery fire. During the first maneuvers held in Tennessee, the tests conducted for this purpose were deemed quite satisfactory and received praise from high ranking artillery officers. The technique used was to fly slowly behind the artillery batteries at 500 to 1000 feet following a figure of eight pattern making each turn toward the target, thus keeping the objective constantly in view of both pilot and observer. The short field landing ability of the little ships made it possible for them to remain close to the batteries and to be instantly available for use.

The appearance of the light planes in maneuvers suggested other uses to which they could be put. They were found particularly useful for courier service and transportation of staff officers and men, locating elements of command, and the general reconnaisance previously described. Delivery of messages was in many cases quicker by light plane than by radio and of course important maps, orders and other information were speeded in delivery over usual ground delivery by motorcycle or car.

One outstanding incident occurred during the desert maneuvers when a radio message was sent to Biggs Field to send a grasshopper to divisional headquarters to pick up important maps. The grasshopper was on the spot in a matter of minutes but it was thirty minutes after the ship arrived that a radio message came through from Biggs saying that the ship was on its way!

Messages in most cases are dropped from the plane, and successful pick-ups were effected with equipment hastily improvised in a few minutes. During the Louisiana maneuvers a regular mail and message service was scheduled and conducted between various command posts. The ships were also used effectively by the Provost Marshall in directing truck convoys into the battle areas. Two way radio communication with the

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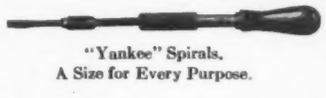

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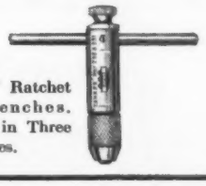

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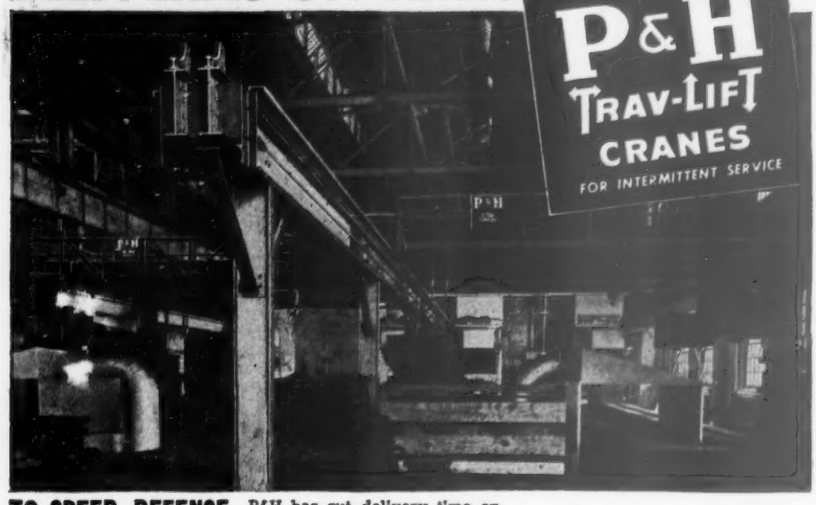

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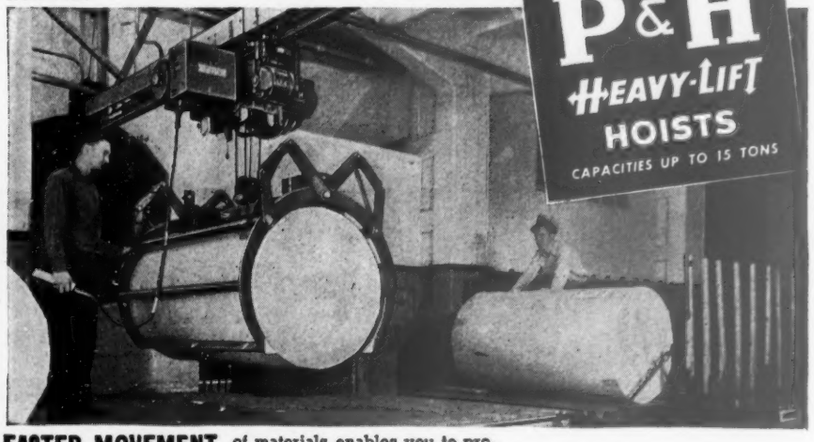

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ground enabled observers to direct traffic, clear congestion and pick out best possible routes. Where ground radios were not available, the pilot was able to shout down directions to the military police on the road.

With the successful acceptance of the light ships for military work, another important development has occurred. This affects the control and operation of the planes. The first 0-59's were procured by the Air Forces and operated by regular commissioned pilots. While there is little doubt that Air Corps pilots are the best trained in the world, their training, being entirely in high powered airplanes, is of little advantage to them in flying the slow ships. During the Carolina maneuvers, there were many 0-59's flown by Air Corps pilots as well as a dozen commercial light ships chartered to the ground forces and flown by factory pilots with several hundred hours light plane time. While this is definitely not intended as a reflection on Air Corps pilots, the civilian pilots did a much better job flying the grasshoppers than the Army pilots. This is understandable as a light plane is as strange to an Army pilot as an A-20 to a light plant pilot.

A satisfactory solution has been reached as this is written by which the ground forces, such as the artillery, or armored forces, will procure their own light planes, and pick their own pilots, possibly from their ranks. There are many enlisted men in all branches who have had excellent experience and a lot of time in the light ships and by whom the opportunity of flying would be regarded as a promotion instead of looking on light plane flying as a demotion, as the typical Air Corps trained pilot might do.

Current plans further call for the setting up of at least one training school where artillery officers will be given practical training in light airplanes. This seems a successful answer to the growing need for air-conditioned ground officers. If and when the light planes get into general use in large quantities, there will be more and more flying and plane riding done by ground officers.

There are many questions still unanswered as to what the light plane will do when it gets into some real shooting. The possibility of immunity from aerial attack is a much discussed problem, the ability of the ships effectively to accomplish their missions under enemy fire is another. The Army's conception of the ships is mainly for behind the lines use and possibly they never will be under enemy fire.

But in my own humble opinion, when things get hot there'll be some modern hero carrying the "message to Garcia" and you'll probably find him flying in a grasshopper.

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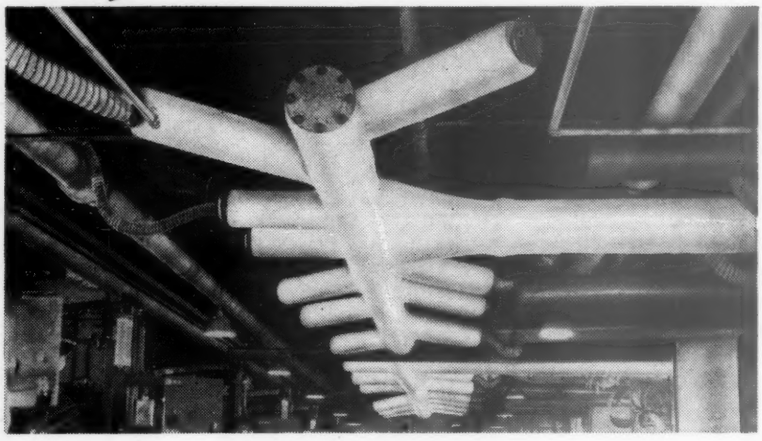
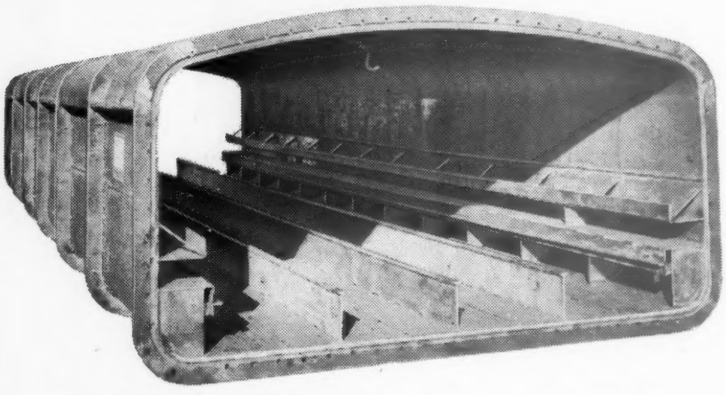
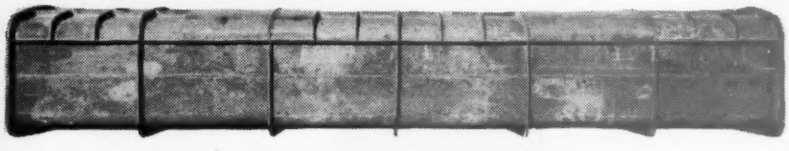


Above is a photograph of the actual installation of an Alloy Exhaust Manifold made for a large motor car manufacturer. It takes exhaust gases from motor testing blocks.



This is an inside view of the Alloy Retort shown below and gives an idea of the way in which special construction is possible to meet customer's specifications.



This is a completed Alloy Retort recently made for a large brass manufacturer. It is 19 ft. 6 in. long, 6 ft. wide, 3 ft. high; weighs 5400 lbs.

The Pressed Steel Company

OF WILKES-BARRE, PENNSYLVANIA

Heli-Coil Bushings

(*Continued from page 81*)

employed in an aircraft cylinder and the latter figure shows the 9/16-12 HC spark plug designed to replace it. The conventionally threaded metal bushing used with the standard 18 mm. spark plug has a 1″-14 NF outer thread which is fitted into the aluminum head with an interference fit of .003-.006 on the pitch diameter of the thread. This bushing is shrink-fitted into place using a suitable lubricant on the thread to seal it against leakage after assembly. The cylinder head and bushing are then drilled and a $\frac{1}{8}$ in. diameter pin is drive-fitted into place. Instead of the above complicated assembly operation, the "Heli-Coil" bushing shown in Fig. 2 is assembled into the cold cylinder head using the special inserting tool provided by the manufacturer. The assembly operation consists of installing the bushing on the inserting tool, screwing the bushing into place, and then breaking off a small lug provided on the bushing for this assembly operation. After removal of the inserting tool the bushing wedges itself firmly in the tapped hole of the cylinder and practically becomes an integral part of this thread. The conventionally threaded bushing used with the standard 18 mm. spark plug has a 1″-14 NF outside thread and the tap employed has an outside diameter of 1.005 in. The area of the hole in the cylinder head produced by this tap is .793 sq. in. The 9/16-12 "Heli-Coil" bushing uses a tap having an outside diameter of .662 in. This produces a hole in the cylinder head having a cross sectional area of .345 sq. in. This area is approximately 44 percent of that required for the conventionally threaded bushing. The appreciable reduction in the cross sectional area of the hole required in the cylinder head is a feature of the helical coil spark plug bushing that is particularly attractive to the aircraft engine designer.

With the "Heli-Coil" bushing a shallow, round bottom thread is employed on the spark plug. The thread groove in the cylinder head is a conventional 60 deg. V-shaped thread. The helical coil employs a coarse thread pitch which allows a deep thread section in the relatively soft aluminum cylinder. The depth of the round bottom thread in the spark plug is approximately one-half that of the V-thread in the cylinder. The steel thread surface of the spark plug contacts the hard wire of the helical coil which, in turn, contacts the relatively soft aluminum alloy. The design of the wire section of this screw connection, therefore, compensates for the

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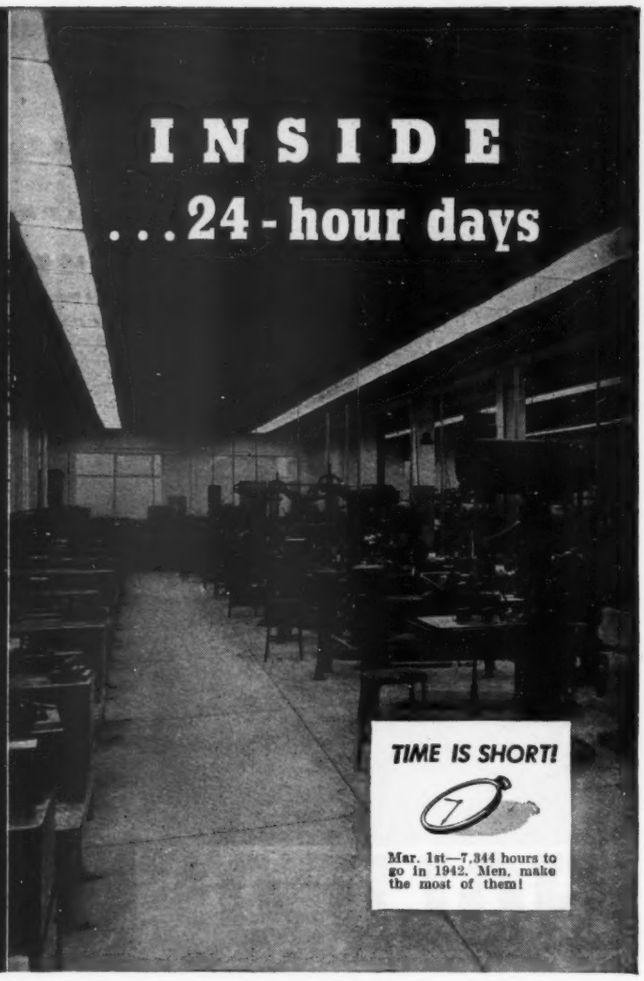

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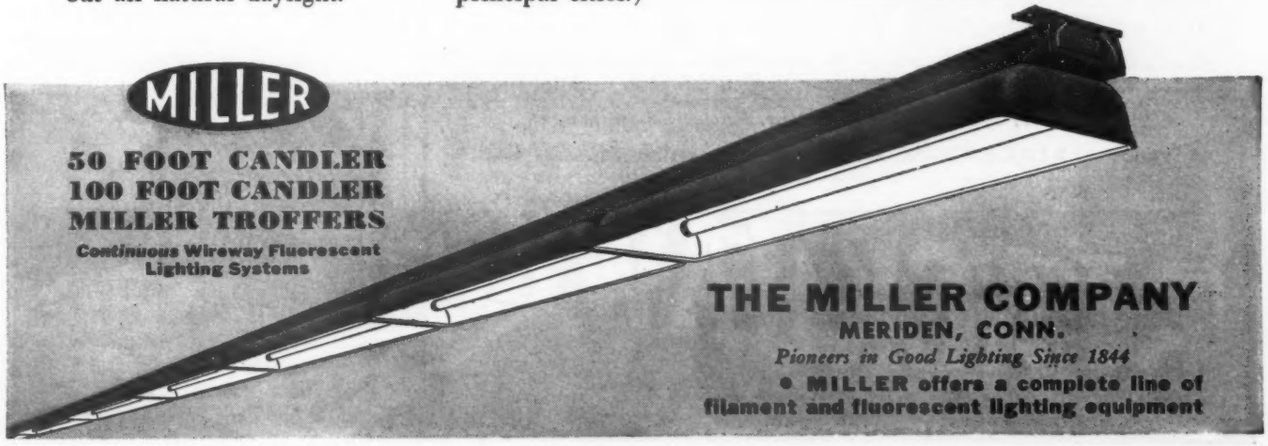

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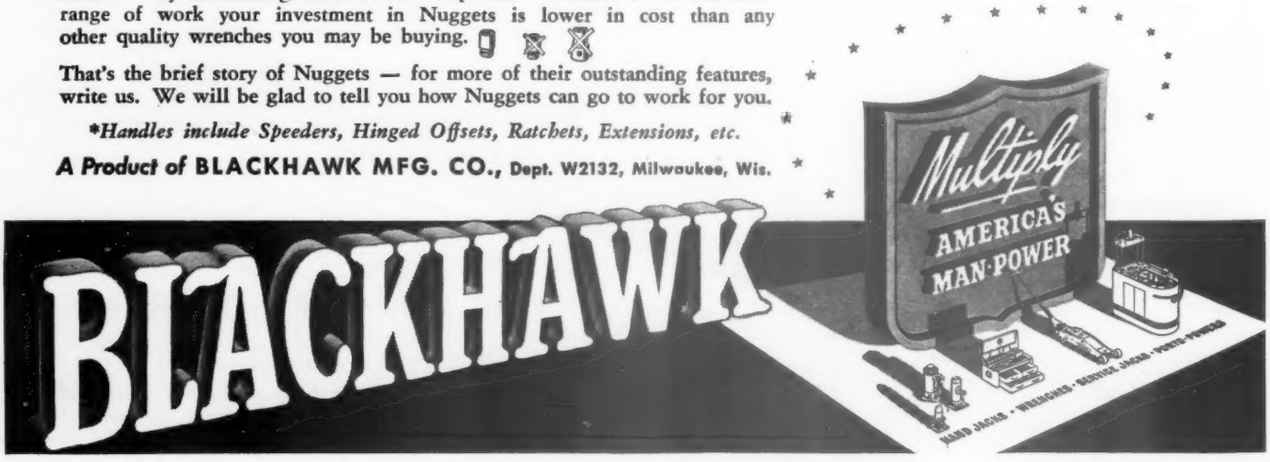

difference in properties of the mating metals. It permits the use of a shallow section, circular groove on the spark plug shell and thereby materially strengthens this member. The coarse thread pitch is also of advantage since it minimizes the possibility of thread crossing in assembly and service operations.

INSERTS NONCORROSIVE

The "Heli-Coil" spark plug inserts are generally made of hard drawn, stainless steel having an accurate, smooth polished surface. The wire composition is such that it will not corrode in storage or in service, nor will it be attacked by the products of combustion resulting from highly leaded gas, even under the most severe operating conditions. The use of this stainless steel, therefore, materially minimizes corrosion of the cylinder head in storage, and prevents the spark plug from being bound in place by an accumulation of corrosion products on the bushing. A further advantage is that these hard wire helical coil bushings cannot be damaged by burrs or rough places on the spark plug thread. The wire is appreciably harder than the spark plug shell material and the helical coil will smooth out any thread burrs or rough spots on the spark plug.

A further advantage of the "Heli-Coil" spark plug bushing that was discovered during its development was the fact that by means of a special tool these helical coils could be removed from the tapped hole without in any way marring or damaging the thread in the cylinder head. This helical coil removing tool makes it possible to replace these bushings in service should they become worn or damaged from continuous use. With the conventional spark plug bushing the replacement of the bushing is generally an operation that must be performed at the factory, so that cylinders are often discarded when the conventional spark plug bushing is damaged to the extent that it requires replacement.

The "Heli-Coil" spark plug bushing permits replacement in service overhaul should this be required. This ability to replace the bushing has been helpful in the initial development tests of the bushing. Service experience to date on the stainless steel wire helical coil bushing has shown that these never wear or are damaged in use, and actual replacement of these bushings in service has not yet been required.

Referring to Fig. 2, which shows a typical installation of a standard "Heli-Coil" spark plug bushing, the cylinder head is tapped out with a conventionally shaped 60 deg. V thread. The "Heli-Coil," which is supplied with an outside diameter slightly larger than the tapped hole, is inserted into the cylinder head by means of a simple tool provided for this purpose. After it is in place the spring tension in the coil, together with the special wire shape employed, insures that the helical coil will wedge itself firmly into the V-thread. The rounded section of the wire projects into the tapped hole and provides a smooth, highly polished, accurately shaped thread surface with which the spark plug shell will engage.

The "Heli-Coil" spark plug bushing was first submitted to many hours of development testing in order to determine the most suitable proportions for the various parts, the required fits, methods of assembly, and the most suitable materials. In these tests the use of the helical coil bushing in place of the conventionally threaded solid metal bushing definitely prevented the recurrence of the cylinder head failures that were experienced in this high power aircraft engine during endurance tests. These tests also showed that the use of the helical coil bushing increased the spark plug life. The stainless steel wire also eliminated the corrosion troubles experienced with bronze bushings.

Following the development tests, service tests were made on the "Heli-Coil" spark plug bushings in modern aircraft engines. These service engines have now been in operation for about one year and the experience with these engines has definitely proven the new spark plug bushing to be superior to the conventionally threaded solid metal bushing by providing longer spark plug life as well as insuring greater engine reliability.

SAVES TIME AND LABOR

At the present time, the use of the helical coil spark plug bushing is exceedingly attractive not only because of the better spark plug performance that is obtained but also because of the time and labor saving it provides in both the manufacture and installation of the bushing. Its use results in an appreciable saving in metal since the weight of the material used in the helical coil is only about 10 percent of that required for the solid metal bushing. There is also a saving of material in the cylinder head since the smaller hole required for the helical coil bushing, together with the elimination of assembly strains resulting from its use, permits a material reduction in the thickness of the cylinder head with a corresponding decrease in its weight.

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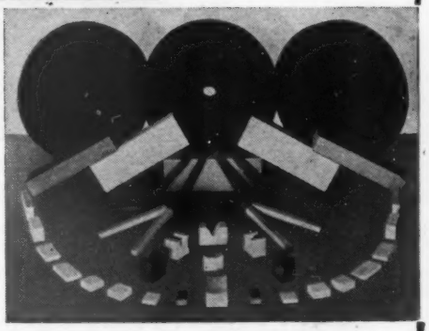

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Hollow Steel Blades

(*Continued from page 71*)

to blade shape between hot dies on a hydraulic press, Fig. 8, the locator and flange registering the tube in proper position. At the proper moment, inert gas under high pressure enters and inflates the tube, which in combination with the dies, creates blade shape. The trailing edge, tip and part of the tip section of the leading edge is resistance seam welded. See Fig. 9.

The locator and triangular portion of the trailing edge are removed to a rough approximation of finished planform. Copper wires are inserted through the shank, along the leading and trailing edges of the blade, placed in a controlled atmosphere furnace. This creates a copper filleted blade, which by this virtue, eliminates stress raisers at the end of the weld.

Figure 10 shows a section of the blade with the copper fillet in the trailing edge. Note also the increased wall thickness at the leading and trailing edges.

The welded and brazed blade is heated and registered between cold dies. High pressure inert gas inflates the blade to an exact duplicate of the die cavity in combination with the die closing operation. It is at this stage that guaranteed duplication is created and insurance that dimensional tolerances will be met. The die quench operation just described, and subsequent draw or tempering phase, presents a blade that satisfies the imposition of heavy service loading.

Figure 11 shows the blade suupended on a plumb line above a microscopic cross hair disc. The polished blade having been so "hung", to obtain measured values of the center of gravity and subsequent vertical balance. Some consideration, of course, has been given to the horizontal balance. Precise balancing, as a result of measured values, produces a uniformly finished blade that is definitely interchangeable.

The blade is finally nitrided in a conventional manner and upon cooling, with the addition of air, there results a durable and corrosion proof finish of dark royal blue color. This combination reduces abrasion and eases reflected light from the blades to the pilot's eyes. Figure 12 shows from top to bottom the finished blades.

The blade is ground on the shank and concentric with a line passing through the center of gravity, following the particular design for blade shank assembly. Figure 13 is a typical shank end, threaded on the outside diameter and Fig. 14 shows the assembly of pilot bearing-worm gear nut, bearings and blade retainer nut.

The blades are inspected magnetically by the magnaflux method, a typical charging set-up of which is shown in Fig. 15, and then demagnetized by passing through the demagnetizing coil of Fig. 16. They are also inspected by X-ray in a technique that presents inclusions, cavities, welding, and brazing defects, if in existence.

Briefly, the magnaflux method consists of charging the blade with direct current of high amperage and completely wetting the blade with a ferrous liquid solution while charged. Discontinuities in the steel set up gatherings of the solution at these points, which are readily discernable by the eye.

A typical example of an X-ray examination is shown in Fig. 17.

Figure 18 shows a tube mill inclusion in the steel, shown by the X-ray process, while Fig. 18 shows this same defect, disclosed by the magnaflux method. The crack or discontinuity actually is located on the inside of the wall.

Hollow steel blades are ready subjects of physical analysis for the proof of design features, such as Harmonic and Oscillograph analyzers for determination of vibration characteristics, electrical resistance pick-up methods in the determination of steady static stresses, breathing stresses, bending and operating stresses. Figure 20 shows a controllable pitch propeller set-up for a vibration stress survey to determine blade vibration stresses throughout the operating range and the vibratory phase relations between any two blade stations. Incidentally, a study of power plant or engine motion was simultaneously made, since the engine motion is a contributory factor in the derivation of vibration stresses.

Figure 21 shows a blade perforated at various points by 30 cal. steel jacketed rifle bullets. The blade was supported in a stationary position at the shank only. The blade station, which would be hit by fixed machine gun fire, is rotating less than 500 feet per second, in comparison with the 2,700 feet per second, bullet muzzle velocity; therefore, the stationary blade used in the experiment should be comparable with service attitude. General blade airfoil shape is apparently unaffected, the damage is restricted to the immediate pierced hole vicinity, particularly on the exit side.

It would appear that the Lycoming process, analysis methods, computations and general scope is complex. To the contrary, a very sound technique is sim-

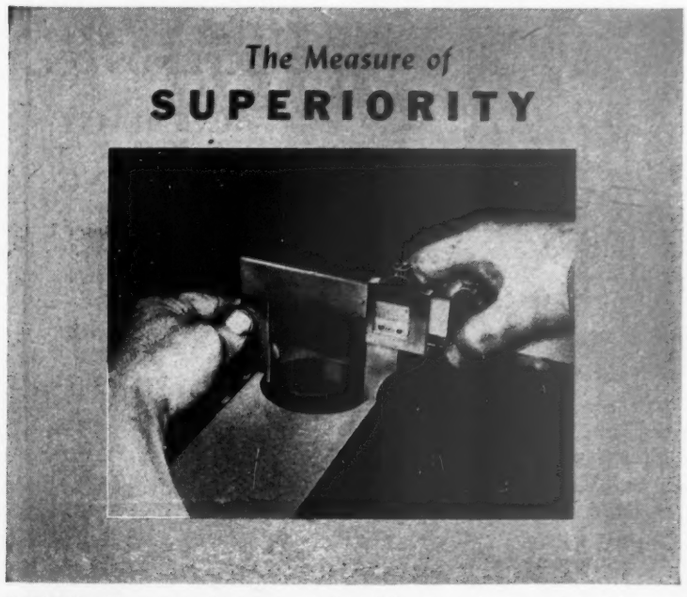

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Figure 22 shows the rough tube in process of internal polishing for removal of scratches, scale, and decarburization. Note the traversing piston which presses the endless emery cloth belt against the interior wall of the rotating tube.

Figure 23 is a view of the toggle swaging machine which reduces the shank end of the tube to a fair contour, so to obtain proper wall thickness. The tube can be seen just entering the halved dies.

Figure 24 shows the trailing edge of the blade passing through the rolls of the resistance welder. The ignitron timer for this welder is shown on the right. Note on the extreme right, a blade with protective gas atmosphere connections being preheated in the resistance welder furnace.

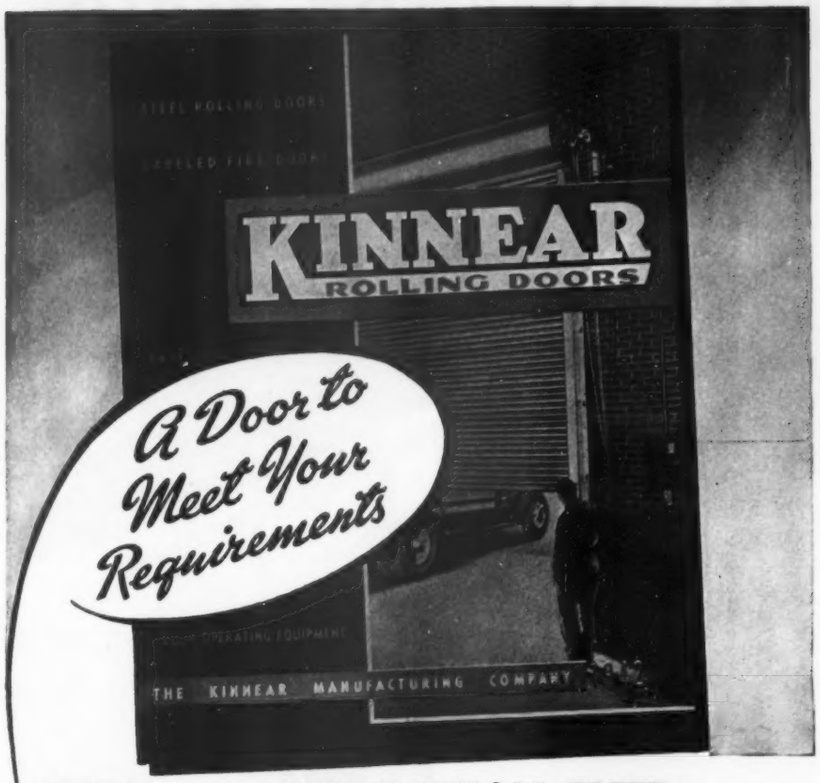
Aircrew Trainees Salvaged

(*Continued from page 137*)

proper landings. Vision correction may be undertaken as a result of K.T.S. examination, by wearing correct vision glasses in the flying goggles. Or it is determined that this man cannot be a pilot because of inability to correctly judge oblique distances.

Also an important reason for fledgling pilots to fall by the way is feminine influence, whether from mother, wife, sweetheart or girl friends. "Well, glad you are still safe" from home or girl friends has a tendency to undermine self-confidence in the student pilot, the lessons of K.T.S. show.

Then some chaps just cannot make the grade on their ground subjects, either for lack of educational background or grasp. This accounts for about ten percent of the pilot ceased and interrupted trainees at Trenton. Then some are unable to overcome airsickness, some are temperamentally unsuited to flying, lack self-confidence, or have an aversion to flying. There was the case of a young fellow holding a civilian license. He had 100 hours solo, had his own plane. He had one bad flying accident experience. But he wanted to join the air force, and since he could fly, applied for pilot classification. He pushed himself through elementary training, soloed, but when he went to a flying service school and had to fly a twin-engined ship, he just couldn't go on; broke down completely. At K.T.S., under tactful man-to-man talks, he finally admitted an aversion to flying. He is serving in the



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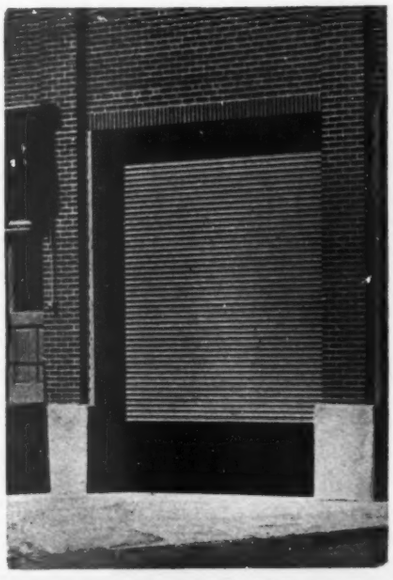

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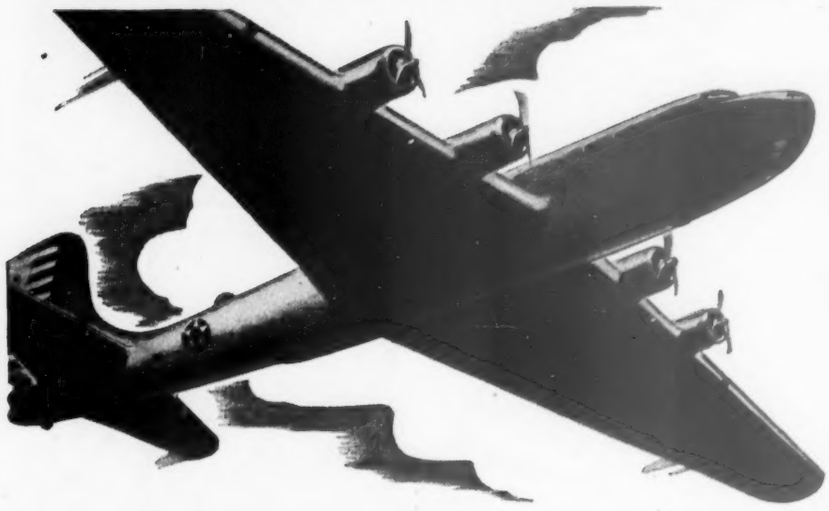

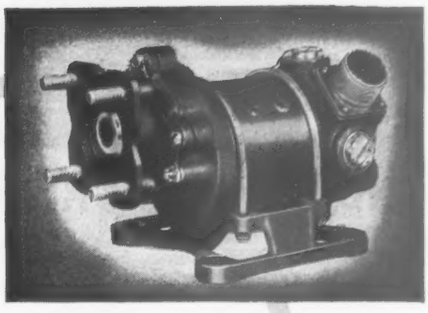

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The bombers and fighters that will give the United Nations control of the skies are now abuilding. And if these are anxious days for us, they are doubly so for the Axis aggressors.

Delco Products supplies the aviation industry with lightweight, explosion-resistant fuel pump motors for starting, transfer and booster duty. These motors conform to latest military aircraft requirements . . . safeguard the flow of fuel under all operating conditions.

Other aircraft equipment and ordnance material are being produced in accordance with Delco Products' assignment. Our employees are united in their determination to help "Keep 'Em Flying" for Victory.

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Division of General Motors Corporation

air force in an important ground capacity.

Then worry of all kinds, whether financial, family or otherwise, has a great effect on flying ability. Ground courses do not show this up, but actual flying training does. A simple example was that of a farm boy, who while taking his flying course was informed of the death of his father. An only son, he began to worry how his mother would manage the harvest alone. It told on his work. At K.T.S. his worries were analyzed, he was given leave to go home, help his mother with the harvest. On returning he completed his course without any further trouble.

Of the ceased and interrupted trainees, the reselection board at K.T.S. sends back slightly over one percent to finish their pilot training, having helped them over their difficulties. About a third of this group go back to finish work as fighter pilots, while the rest become staff pilots, taking a part of the work at training stations of various kinds. The bulk, 40.25 percent during the first half year of operation of K.T.S., were sent back to train as observers, and most of them in their reports confess they are sold on the more difficult observer course, having had no idea as to its interesting nature. More than half of the unsuccessful pilot trainees become successful observers.

About ten percent of those at K.T.S. go out to take courses as wireless-gunners, and 13.5 percent as straight air gunners. Twenty-two percent take ground trades, which includes everything from clerical work to regional control officers, highly specialized jobs. The rest, about twelve percent, are discharged, either because of physical reasons, or because they joined under the R.C.A.F. regulations only as aircrew and did not want ground posts. Enlistment regulations, since November 1941, cover aircrew and ground work, eliminating a percentage of possible discharges allowed under the old system should the recruit not make the grade in his aircrew work.

Despite the short time that K.T.S. Aircrew Squadron has been in existence, a number of lessons have been learned from its operations, some of which are in the process of being adopted for the training and selection of aircrews in the R.C.A.F. Incidentally, New Zealand has adopted a similar Composite Training School, and it has been under investigation by United States Navy air force officers.

One lesson from the K.T.S. has been the need for establishing boards at each training school where each trainee can discuss his case before being remustered. At such boards instructors and officers are present, and the trainee is questioned and given an opportunity to give his

Throughout history those three words have repeatedly provided the stimulant that has enabled a small force of heroic defenders to hold out against apparently insurmountable odds.

In similar situations now existing it is extremely gratifying to us to know that, in both the production and maintenance of airplane engines, HALL equipment is helping speed up those reinforcements by providing valve seats of finer precision and finish faster than was ever before possible.

If YOU have a valve seat grinding problem in production or a valve seat or valve face grinding problem in maintenance, it will pay you to consult HALL engineers.

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It's significant that the makers of aircraft who made the "*Grasshopper Squadron*" won their "*Grasshopper Wings*" with famous *Continental* "65" H.P. Red Seal Engines

Taylorcraft 0-57, Aeronca 0-58, and Piper 0-59 have all passed the service testing period with that great performer —the Continental 65 H.P. Red Seal Engine—and are now hailed as Charter Members of the "Grasshopper Squadron." Once again Continental proves, "It's the performance that counts." Short take-offs—quick and steep climbs, dependable maneuvering—spot landings and plenty of speed when needed. Yes, the "Grasshopper Squadron" demands plenty of dependable, actual horsepower, and Continental Red Seal Engines have it.

Continental Motors Corporation

MUSKEGON, MICHIGAN

side of the story should he be in line for remustering on report of his progress.

A standard form and personality sketch for selection purposes has been suggested by medical officers who study the trainees' background, one in which psychiatric terminology will be standardized. Such case histories can do much to aid medical officers on selection boards in determining fitness of recruits for specific aircrew training. It has also been suggested that a psychologist be stationed at recruiting centers there to interview recruits on their qualifications for aircrew.

Specific lessons for application to mass production of aircrew have not yet been developed because the entire K.T.S. Aircrew Squadron plan so far has been experimental, has been a matter of groping and searching, with mistakes admitted. Standardized practices have not yet been completely developed, sufficient men have not yet passed through K.T.S., and finished their courses and gone into actual combat work, to procure statistics for adoption to training. But enough of a start has been made, sufficient men have passed through K.T.S. to clearly demonstrate its value in saving morale, men and money spent on training.

Private Flying

(*Continued from page 150*)

have some definite military value, important enough to require drastic control.

One prominent aircraft manufacturer, with whom I talked recently, correctly points out this odd situation whereby the military authorities recognize potential destructive value from light airplanes on the home front but fail to concede that this same offensive power of the light airplanes could be used against the enemy.

Of course, the light airplane has already been adopted by the Army, but for behind-the-lines operation. The thought of using light ships for offensive work, was enthusiastically expressed to me by one of the nation's top ranking acrobatic pilots, who has flown all types of airplanes and holds ratings on everything below four engine jobs. He visualizes units of 500 and 1,000 light planes with each ship loaded with two 50 pound bombs, one machine gun, and smoke laying equipment. By sheer numbers in close formation, this authoritative pilot claims that the entire area under attack would be covered by machine gun fire, and subject to terrific bomb coverage. With each ship laying down smoke, the enemy would be completely unable to return fire. Other logical suggestions for civilian type planes is convoy work, using the planes off the limited deck space available even on small freighters. When it is remembered that light airplanes have been landed time and again on the top of automobiles, one can get an idea of the limited space needed on a ship to land such a plane. A 250 pound depth charge could be carried easily by each plane.

Radio

(*Continued from page 135*)

a control circuit will deliver power to an electric motor when the loop antenna is in any position other than the correct zero signal or null position. The shaft of the motor is geared to the shaft of the loop so that application of power to the motor causes the loop to rotate toward the null. The control circuit ceases to supply power to the motor when the loop reaches its null position. If the position of the loop antenna is changed to either side of its null, or if the direction of arrival of the radio signal is changed, the control circuit immediately returns the loop to the null position. The angular position of the loop is transmitted to a remote bearing indicator by an electrical indicating system. The azimuth scale of the bearing indicator is calibrated in degrees so that the radio bearing corresponding to the null position of the loop will be indicated directly by the pointer. Ambiguities of 180 degrees in direction are eliminated by making the control circuits stable on only one of the two null positions of the loop antenna.

With the automatic radio compass just described, to get a positive fix it is necessary to obtain indications from at least two and preferably three radio transmitters. It is a simple step to combine on one dial the indications of two separate automatic radio compasses so that bearings on two transmitters may be made simultaneously. Thus the pilot has at his disposal an instrument which under certain conditions performs all the functions of navigation. He may fly along a straight line between two transmitters by having the two pointers on the compass dial pointing diametrically opposite or he may fly along that same line extended by having the pointers both point in the same direction. A

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description of the operation of the dual automatic radio compass was published in the June, 1941, issue of AVIATION.

One of the latest developments, not in production at present, is the combination of an automatic radio compass with a stabilized remote indicating magnetic compass. The two units are coupled to a common indicator. The remote reading compass is coupled to the azimuth scale of the radio bearing indicator, while the automatic radio compass actuates the pointer of the indicator. This combination affords a means of continuously and automatically indicating the bearing of a given radio station with respect to Magnetic North instead of the aircraft heading. Since magnetic radio bearings may be obtained directly from the indicator for any heading of the aircraft, the necessity of holding a pre-determined aircraft heading for position fixes is eliminated. The device may also be used for flying an infinite number of radial courses toward or away from a single radio station since there is only one line to the radio station having a given bearing with respect to Magnetic North.

Preventive Maintenance

(*Continued from page 130*)

of wings for an inspection of the concealed structure. The interior is cleaned and inspected. Replacement is made, if necessary, of all control cables.

The fuel oil, hydraulic and control systems are given a thorough inspection and overhaul. All control surfaces—rudder, elevators and ailerons—are removed for inspection of attachment fittings and a complete inspection of the control surface units. The entire electrical system is inspected and switches, wiring and motors are tested for continuity and proper operation. The gasoline tanks are removed for periodic inspection, and tanks which have been reconditioned and tested installed to replace them. The entire heating and ventilating system is checked.

Landing gear and tail wheel assemblies are removed and torn down for examination. Also scheduled for thorough inspection are items of miscellaneous equipment, such as de-icers, oxygen systems, power plant control system and warning lights for the landing gear position and fuel and oil systems.

The next visit of a Flagship to the overhaul shop is termed "Operation 3," which is scheduled each 18 months or 3,500 hours of skylane work. The plane is in Hangar 5 for a six-day period, during which virtually all the procedure of "Operation 2" is repeated. However, with the longer stay in the shop, the plane is subjected to a great deal of general reconditioning.

"Operation 4" has been designated as a general "catch-up" period for all engineering changes and minor repair work when there is no airplane in the shop for "Operation 2."

Capable of handling three airplanes at one time, the shop facilities nevertheless have been found to operate most efficiently when two airplanes are scheduled in simultaneously, one for an "Operation 2" procedure and the other for "Operation 3." On a 24-hr. basis of working three shifts on each ship, the economical distribution of available man-hours assures the release of these airplanes back to flight schedule in conformance with the predetermined program.

APPRENTICE MECHANICS TRAINED

To maintain the supply of well trained aviation mechanics, American Airlines has set up an apprentice mechanics training school that was the first of its kind among the airlines. About 150 young men are now enrolled and they have the advantage of working on the planes under the close supervision of expert mechanics while they are learning. The apprentices take two evening sessions a week under experts in each phase of airplane maintenance.

Probably the most meticulous work is overhauling the Flagship engines. Every single part is taken down, cleaned, inspected, replaced if necessary and the engine rebuilt. The inspection includes use of the magnaflux system—each part is magnetized and then suspended in a bath of iron filings. Particles of iron cling wherever there is any flaw in the metal, thus exposing defects invisible even to the eye of an experienced inspector.

Overhauled motors are first given a six hour run on test stands designed by American Airlines engineers. Again it is inspected, and then it must be test flown before going out on a Flagship schedule.

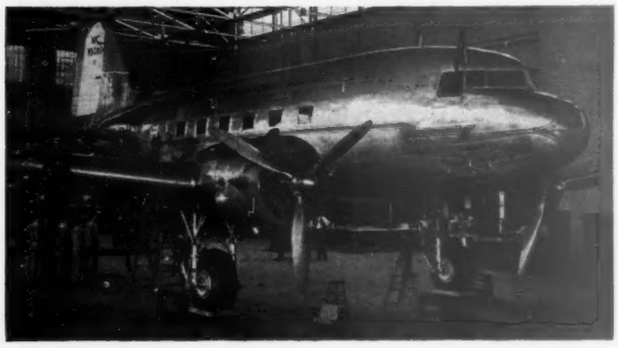
"Feeling like a new plane," the Flagship finally takes its first load of passengers on a scheduled flight. A careful overhaul job has turned over to the captain a ship literally "good as new." Pilots say they like overhauled ships just as well as brand new ones.

To the maintenance men of the airlines must go much credit for their part in providing adequate air transportation at a time when the national emergency demands it.

Parachuting

(*Continued from page 143*)

been the chief reason for the propaganda campaign. Others in the course of their compulsory military service in the Red Army (a two-year period which begins at 18) joined the infantry. Generals discovered that in addition to the regular air arm that was attached to each division there were thousands in the infantry ranks who had had experience as parachute jumpers. It occurred to the military leaders to separate these parachute jumpers into detachments for special training. Thus



5. A Flagship is setup in flight position for the official weighing which usually is done as the final step in a major ship overhaul.

6. Completely "done over" and fit as a fiddle, a Flagship is wheeled out of a LaGuardia Field hangar for a thorough test flight.

the first parachute troops were born.

The Red strategists believed that revolution in the west was no longer possible by the spontaneous action of the workers. Revolution there would come, as it had come in Russia, through war. When it came, Soviet parachute troops dropping from the skies into the workers' centers behind the lines would organize the workers to fight in the rear of the capitalist armies. The parachute troops had, therefore, a very lofty mission; they formed a sort of elite in the army ranks.

In 1935 as senior officer of the Red Army reserve, I was recalled for periodic three months' training in General Staff work. Army maneuvers in which I assisted were conducted in the Western Ukraine. Military observers from a number of Western Powers were on hand. General Jonah Yakir was in charge of maneuvers which were attended by Marshals Voroshilov, Tukachevsky and a number of high ranking Soviet officers. From a platform built on top of a high outlook we watched the armies engaged in simulated battle.

The first use of parachute troops to capture a landing field for the landing of troop transports was deeply impressive. The entire operation took a matter of minutes. A whole brigade of 3,500 men with light tanks and artillery descended from the skies. All the foreign observers expressed their admiration at the development of this new tactic. It was clear to all that here was something of the greatest importance to military strategy. I am certain that no military observer failed to point out its significance to his government. Apparently the British and French High Commands ignored the development as a new-fangled gadget without real importance. Only the Reichswehr generals appreciated its meaning.

Hitler wasted no time in building a parachute army of his own. Applying German efficiency and organization technique to the idea taken from the Russians, he went far beyond the Soviet achievement in this field. Meanwhile, in his purge of the Red Army, Stalin liquidated the Soviet innovations along with the army leadership. The result was that the first attempt on the part of the Russians to use the parachute troops in the Finnish war was not successful. Instead of being welcomed by Finnish workers waiting to break the bonds of capitalism, the Soviet parachute troops, dropped behind the Finnish lines, were shot down by indignant Finns ready to defend themselves against the army of Soviet totalitarianism. The Germans, more skillful and better organized for this sort of war, had better luck. Everyone learned the deadly effectiveness of parachute troops during Hitler's campaign against Poland, the Low Countries and France.

But Americans did not know when they read the headlines telling of this new type of warfare that the idea of parachute troops had its origin in the mind of a Soviet airman, watching the response of the crowd to a parachute stunter at an American fair.

Seadrome System

(*Continued from page 145*)

Seaplane bases equipped with these lights can handle heavy seaplane traffic quickly and safely. The regular patterns of distinctive lights are visible for three to five miles during normally clear weather, and for full visibility ranges during limited visibility conditions of three miles or less. That is, lights would be visible for one mile in weather classed as one mile visibility.

While it is possible greatly to increase the light output of these units, such increases have proven unnecessary and uneconomical. The balance between light output and battery cost has been carefully peaked at the optimum points on the performance curves so that any increase or decrease in light output results in increased cost per lumen-hour. Any other known battery combination at any light output also increases the cost per lumen-hour. The fixed base radio controlled boundary light, giving 120 flashes per minute, will operate for about 400 hr. during a three month period for the same cost per unit. The portable contact light will operate about 30 hr. during a three month period on a battery and service cost of less than $2.00 per unit.

For normal operations, the installation and maintenance costs of this type of seadrome lighting compare quite favorably with those at airports with the added advantage of lower overall construction costs. With the difficult problem of night lighting now taken care of, seaplane transportation can undertake 'round the clock operations.

Sheet Metal Forming

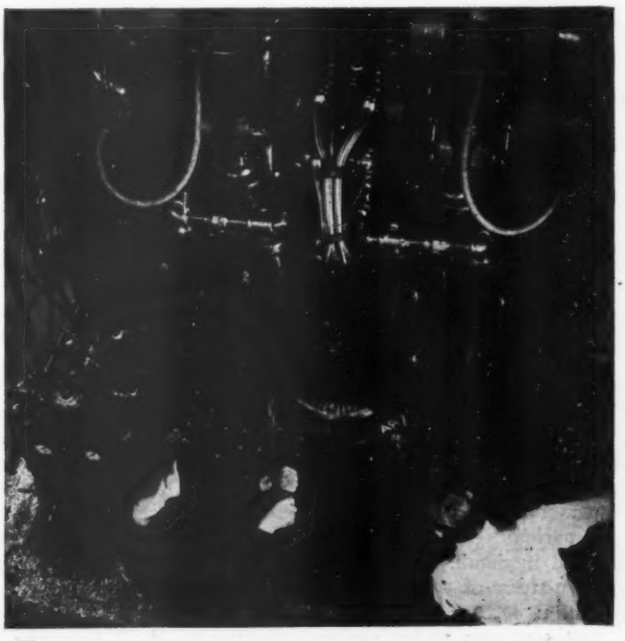
(*Continued from page 65*)

lighter gages can be formed by this progressive method than can be formed on the drop hammer or other types of presses. And the time factor is cut to a fraction of that required by any other method. The thickness of the metal and the shape of the part determines how fast the draw can be made. This depth is adjustable by means of a master control valve and can be pre-determined and set for any production job following a period of preliminary experimentation. The depth of draw with each stroke is variable from ⅛ to a full inch. The press speed may vary with the size of press used but will usually run around 32 strokes per minute.

A 2-in. stroke press can be equipped to make a 16-in. draw by the Misfeldt method. This drawing technique can be applied to almost all straight side punch presses and is incorporated in the design of a special type hydraulically operated drop hammer.

With the development of a national rubber shortage a further advantage of the Misfeldt method is that it does not require the large rubber pads commonly used for hydraulic press or drop hammer work.

Also, since a single die may often replace the series dies used with the drop hammer, it is possible to save on zinc, another critical defense item.



6. In this view of the super-structure of the Bliss press, note hydraulic cylinders. Eight of these govern position of the blank holder.

B. C. BOULTON

ALEXANDER KLEMIN

GROVER LOENING

E. BURKE WILFORD

sible to save 41,000,000 lb. of aluminum per year by utilizing these materials in all aircraft applications in which they are equally suitable, and in which they do not affect the overall design of the airplanes upon which they are used. A number of aircraft applications are described and the availability of materials is considered satisfactory.

In their paper on welding chrome molybdenum steels, Messrs. Evans and Netchvolodoff (Curtiss-Wright Corp.) point out that no other welding method presents such a low unit cost, possible saving in weight, excellent appearance and uniform cross section through the joints as flash butt welding. With the proper set-up and equipment, the human element may be practically eliminated and extensive instruction of operating personnel is not required. The only prerequisites for the use of this process at the present time are large production, relative simplicity of part design, proper equipment, and a knowledge of the variables of the welding process.

The paper describes the physical characteristics of chrome moly steel from the welding viewpoint; current welding and post-welding practice; and the excellence of the results that can be expected from properly controlled flash butt welding procedure.

The vital necessity of establishing a definite control procedure for torch welding operations in aircraft plants was emphasized in the paper presented by Mr. Eric Dudley (Curtiss-Wright Corp.). In describing this control procedure, the paper outlines, in detail, the organizational set up required to make the control effective and complete. A personnel classification is proposed and a periodic examination routine is outlined in detail.

A study of the magnetic field distribution in an eccentrically cylindrical test specimen under various conditions of magnetic flaw inspection was described by Mr. Fernly L. Fuller (Ranger Aircraft Engines). Where large magnetizing currents are employed there exists a magnetic saturation in the thin section (resulting in high surface leakage and consequently definite indications of flow line patterns) which exerts a choking action and causes a complete lack of saturation in the thick section where no leakage or flow line pattern appears. A method is described for avoiding the saturation of this type of specimen and of producing substantially uniform magnetization with greater consistency of flaw indication. In addition, this device permits the use of lower magnetizing currents.

DESIGN

A frank plea to designers to give full consideration to the occurrence of repeated loads in the design of aircraft structures was made by Mr. Harold E. Hoben (American Airlines). While materials are selected and structures designed to meet certain design stresses, insufficient attention is given to fatigue characteristics in many cases. The paper briefly discusses endurance of structures, noting the effects of varying ranges of stress, of different types of materials, and of stress raisers. It is believed that fatigue failures in airplanes can be eliminated to the extent that it has been in modern engines and propellers if due diligence is applied.

Design charts which may be used for the design of round chrome-molybdenum tubing either in bending or torsion alone, or under combined bending and torsion were presented by Mr. V. C. Trimarchi of the Rensselaer Polytechnic Institute. The general case of combined bending and torsion is simplified by use of the "equivalent" moments method and is treated in detail. Several examples illustrating the use of the charts are included in the paper.

The design of flexibly mounted rotor blades is discussed in a paper by Mr. R. H. Prewitt (Kellett Autogiro Corp.). General aerodynamics and design of the blade, bending moments, blade weight estimates, and typical blade construction is dealt with in the paper. While the discussion is mainly directed to the autorotating blade, a considerable portion of it is applicable to the power driven rotor.

Alexander Klemin, of New York University, offered formulas for the determination of rotor bending moments in the plane of flapping which will undoubtedly place stress analysis of the rotor on a sounder basis. Dr. Klemin's formulas are based on aerodynamic considerations and take into account the effects of blade weight, centrifugal force, and inertia forces. The treatment has been extended to varied operating conditions of the rotor, to varied values of the azimuth angle, and to varied positions along the blade. Full allowance has been made for centrifugal relief. The calculations based on these more rigorous methods check fairly well with the empirical formulas.

A number of interesting new developments in simplified control of aircraft was described by Mr. Ralph H. Upson (Stout Skycraft Corp.). A primary control, in which flaps are coordinated with elevator, and rudder with ailerons, is advocated. A possible supplementary pedal control is discussed which would deflect two rudders in opposite directions to coordinate ground brakes with air drag. Several advantages of an automobile-type wheel arrangement are noted. Considered from the standpoint of simplified control are special problems such as stability against overturning on the ground, inertia loads on the wing, spiral stability, and control requirements for following a course.

Criteria for tricycle landing gear design are presented by Messrs. E. S. Jenkins and A. F. Donovan (Curtiss-Wright Corp.). Their paper considers the general geometric arrangement of the gear as well as problems related specifically to the design of the nosewheel. Special attention is given to the elimination of shimmy by damping and methods are offered for the calculation of the amount of necessary damping under various design conditions.

In determining the buckling strength of I-beams with unlike flanges it is not possible to use the available formulas applicable to I-beams of symmetrical cross section. In his paper on the lateral instability of unsymmetrical I-beams, Mr. H. N. Hill (Aluminum Co. of America) derives an expression for the bending moment at which such a beam will become unstable when subjected to constant bending throughout its laterally unsupported length. The expression includes a term which takes account of varying degrees of restraint at the ends of the unsupported length.

RESEARCH

Messrs. Emerson W. Conlon and John C. Mathes (Dow Chemical Co.) described the preliminary static test of a magnesium alloy wing and made a few

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Papers Presented at the Tenth Annual Meeting of the Institute of Aeronautical Sciences

* Indicates paper restricted for publication.

PRODUCTION

X-Ray of Aircraft Castings—Its Control and Value—B. C. Boulton, Lockheed Aircraft Corporation

Economic Advantages of Certain Aluminum Alloys for Aircraft Construction—Kirby F. Thornton, Aluminum Co. of America.

Flash Butt Welding of Chrome Moly Steel—W. Stewart Evans and V. V. Netchvolodoff, Airplane Division, St. Louis Plant, Curtiss-Wright Corporation

Advances in Production and Assembly of Plywood in Aircraft Production—Hugh G. Bersie and Edwin R. Clarke, Haskelite Manufacturing Company

Use of Plastics and Allied Materials in Aircraft Construction—George W. DeBell, The Glenn L. Martin Co.

Effect of Magneto Field Distribution in Magnetic Inspection—F. L. Fuller, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation

Control Procedure of Torch Welding in Aircraft—Eric Dudley, Airplane Division, Buffalo Plant, Curtiss-Wright Corporation.

Elastic Theory as a Tool in Sheet Metal Forming Problems—F. R. Shanley, Lockheed Aircraft Corporation

A Few Engineering Aspects of Elastic Behavior of Anisotropic Materials—Michael Watter, Edward G. Budd Manufacturing Company

A New Type of Preformed Structural Plastic—A. A. Bates, Westinghouse Electric Research Laboratories

Tension and Compression Stress-Strain Characteristics of Cold-Rolled Austenitic Chromium-Nickel and Chromium-Manganese-Nickel Stainless Steels—Russel Franks and W. O. Binder, Union Carbide and Carbon Research Laboratories

Resin-bonded Wood Laminates for Shell Type Aircraft Structures—Alfred A. Gassner, Duramold Aircraft Corporation

Aluminum Alloys for Aircraft—T. L. Fritzlen, Reynolds Metals Company.

Review of Present Day Welding of Aircraft Steels—A. J. Williamson and J. P. Dods, Summerill Tubing Company

DESIGN

Bending and Torsional Design Charts for Round Chrome-Molybdenum Tubing—Vincent C. Trimarchi, Rensselaer Polytechnic Institute

The Lateral Instability of Unsymmetrical I-Beams—H. N. Hill, Aluminum Company of America

Fatigue Failures Affecting Air Transport Aircraft—Harold E. Hoben, American Airlines

Beryilium in Aircraft Design—E. Burke Wilford, Pennsylvania Aircraft Syndicate

A Theory for the Buckling of Curved Shells—Hsue-shen Tsien, California Institute of Technology

New Developments in Simplified Control Ralph H. Upson, Stout Skycraft Corporation

*Aircraft Engine Installation and Its Effects on Engine Design—E. C. Sulzman, Wright Aeronautical Corp.

Rotor Bending Moments in Plane of Flapping—Alexander Klemin, New York University, assisted by Wayne Wiesner, Kellett Autogiro Corporation, and W. C. Walling, New York University

Rotor Blade Design—Richard H. Prewitt, Kellet Autogiro Corporation

Tricycle Landing Gear Design—E. S. Jenkins and A. F. Donovan, Airplane Division, Buffalo Plant, Curtiss-Wright Corporation

Recent Developments and Flights of the VS-300 Helicopter—Igor I. Sikorsky, Vought-Sikorsky Aircraft Division, United Aircraft Corporation

General Flight Analysis of the Helicopter—Montgomery Knight, Georgia Institute of Technology

Load Factors Obtained on Civil Airplanes in Acrobatic Maneuvers—Edward I. Ryder, Civil Aeronautics Administration

Stress Analysis of Rings for Monocoque Fuselages—N. J. Hoff, Polytechnic Institute of Brooklyn

RESEARCH

Design and Static Tests of a Magnesium Alloy Wing—Emerson W. Conlon, University of Michigan and John C. Mathes, Dow Chemical Company

A New Two-Parameter Model Suspension System for the GALCIT 10-Ft. Wind Tunnel—Arthur L. Klein, Peter V. H. Serrell and Clark B. Millikan, California Institute of Technology

Wall Interference Effects on Stalling and Drag in an Elliptical Wind Tunnel—Joseph G. Gavin, Jr. and Rudolph W. Hensel, Massachusetts Institute of Technology

A Kinetc Energy Correction to Predicted Rate of Climb—Frederick C. Phillips, The Glenn L. Martin Company

*Notes on a Propeller Hub Development—C. S. MacNeil, Aeroproducts Division, General Motors Corporation

The Correction of Engine Output to Standard Conditions—Donald S. Hersel, Pratt & Whitney Aircraft Division, United Aircraft Corporation

Ground Vibration Tests—D. Pengelley, Airplane Division, St. Louis Plant, Curtiss-Wright Corporation

A Simple Method of Applying the Compressibility Correction Factor in the Determination of True Airspeed—W. C. Schoolfield, Vought-Sikorsky Aircraft Division, United Aircraft Corporation

Dynamic Balancing as Applied to Aircraft Propellers—R. D. Speas and J. C. Luttrell, American Airlines

Propeller Forces due to Yaw and their Effect upon Airplane Stability—L. B. Rumph, R. J. White and H. R. Grumman, Airplane Division, St. Louis Plant, Curtiss-Wright Corporation

*Vector Solution of the Three Degree Case of Wing Bending, Wing Torsion, Aileron Flutter—Lee Arnold, Republic Aircraft Corporation

The Space Time Recoder—F. N. M. Brown, University of Notre Dame

AIR TRANSPORT

Air Express and Freight, the Past, Present and Future—C. G. Peterson, Railway Express Agency

Operating Requirements for Cargo Transportation—Charles P. Graddick, United Air Lines Transport Corporation

*Development and Applcation of the Curtiss-Wright Combustion Heater—Joseph J. Jerger, Curtiss-Wright Corporation

*Flight Test Organization, Procedures, and Crew Training—Albert C. Reed and William F. Milliken, Jr., Boeing Aircraft Company

Economic Effects of Airport Size and Airway Deficiencies on Air Transportation—A. E. Blomquist, Eastern Air Lines

The Automatic Radio Compass—Wilbur L. Webb and Gerald O. Essex, Bendix Radio Corporation Division, Bendix Aviation Corporation

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Certain Applications to North America of P. Queney's Theory on the Influence of Relief upon the Dynamics of the Air—Walter M. Elsasser, Blue Hill Observatory, Harvard University

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Lightning and Aircraft—Otto E. Kirchner and W. A. Petrasek, American Airlines

A Note on Determining the Universal Turbulance Constant in the Atmosphere—Benjamin G. Holzman, U. S. Weather Bureau

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*The Ten Thousand Foot Constant Level Chart and its Use in Weather Forecasting—E. J. Minser, Transcontinental & Western Air

*A Preliminary Report on Methods and Results of Weather Forecasting by Means of Case Histories—J. J. George, Eastern Air Lines

PHYSIOLOGIC PROBLEMS

*Physiological and Psychomotor Tests in the Selection of Pilots—Ross A. McFarland, Harvard University

*Gas Exchange in the Lungs at High Altitudes—David B. Dill and F. G. Hall, U. S. Army Aero Medical Research Laboratory

*The Problems Inherent in the Protection of Flying Personnel Against the Temperature Extremes Encountered in Flight—Otis O. Benson, Jr. and Ernest A. Pinson, U. S. Army Aero Medical Research Laboratory

*The Physiologic Aspects of a Free-fall Parachute Jump—Andrew C. Ivy, Northwestern University, and Arthur H. Starnes

*General Review of the C.A.A.-N.R.C. Research Program—J. G. Jenkins, University of Maryland

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*Analysis of Instruction by Recording Instructor-Student Conversations During Flight—E. Lowell Kelly, Purdue University

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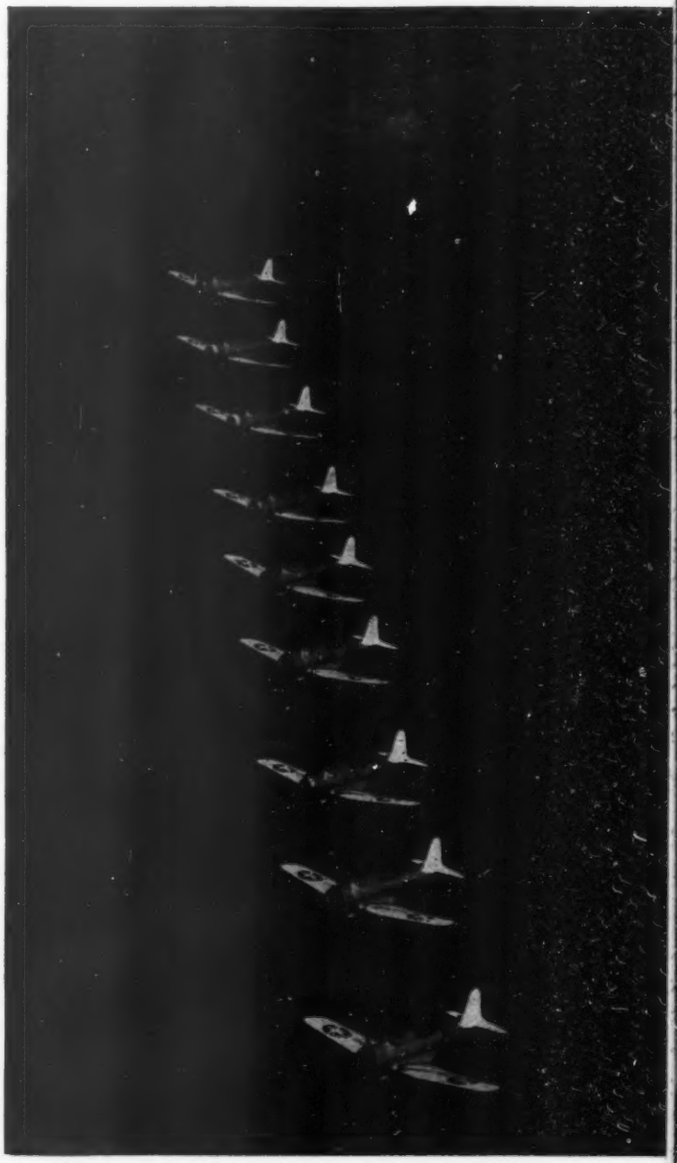

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interesting comparisons with aluminum structures. The greater tip deflection of the experimental magnesium wing and the lesser torsional rigidity were consistent with the weight differential between magnesium and aluminum structures. Calculations indicated little change in critical flutter speed because of the decrease in both the torsional and bending rigidity. Desirability of the development was indicated by the weight saving possibilities, low specific gravity in the design and construction of more nearly pure monocoque assemblies, lower costs, added space in the structure for equipment, and smooth surfaces obtainable.

In his paper on ground vibration tests, Mr. C. D. Pengelley (Curtiss-Wright Corp.) discusses the dynamics of a rigid body having two degrees of freedom and presents computation charts for the rapid solution of nodal positions. Charts are also included from which the uncoupled frequencies, as required in flutter analysis, may be quickly evaluated from data observed during vibration tests. He pointed out that neglect of this item may produce an unconservative error of 20 percent in the calculated flutter speed.

A theoretical analysis is made of the factors affecting the power and unbalance required to conduct vibration tests. An interesting discussion of the new Curtiss-Wright Universal Vibrator is also included in the paper.

The reduction of noise and vibration in transport airplanes was discussed by Messrs. Luttrell and Speas (American Airlines) in their paper on dynamic balancing of propellers after mounting. A created out-of-balance of known magnitude is applied to the propeller blade making it possible to determine the original unbalance from data obtained from a vibration indicator mounted on the control column of the airplane. The procedure is not complex or unduly time-consuming and can be carried out by the mechanics in check-up routine.

TESTING SUPERCHARGED ENGINES

In order to provide a common basis for the comparison of high-performance supercharged aircraft engines, Mr. D. S. Hersey (Pratt & Whitney) has proposed formulas for correcting the measured output to standard atmospheric conditions. The generally used correction formulas developed for naturally-aspirated engines are found to be inadequate when applied to supercharged engine test data. In the development of the proposed correction formulas, the theoretical effects of atmospheric changes on the performance of an engine's induction system units are discussed and applied in a general basic correction formula. Expressions are evolved covering both full-throttle and part-throttle operation of single-stage supercharged engines and for two-stage engines of the gear-driven and turbo-driven variety.

RATE-OF-CLIMB STUDIES

The trend toward higher operating altitudes and higher loadings for military aircraft makes it necessary to establish more accurate guarantees of predicted rate of climb. The errors incurred by assumption of zero acceleration along the flight path are analyzed and methods for correlating computed and flight rates of climb under various conditions of loading and altitude are proposed in the paper by Mr. Frederick C. Phillips (Glenn L. Martin Co.).

In his paper on the determination of true airspeed Mr. Wm. C. Schoolfield (Vought-Sikorsky) pointed out that the large increases in maximum speed and operating altitude have brought new factors into being that render the customary methods of determining high speed inadequate from the viewpoint of strict accuracy. A simple method of applying compressibility correction in the determination of true airspeed is proposed. The method follows as closely as possible the procedure used in the past and additional calculations required are reduced to a minimum.

AIR TRANSPORT

Warning that air cargo operations would meet keen competition and must be established on the soundest economic principles, Mr. Charles P. Graddick (United Air Lines) discussed the feasibility of operations on a large scale and predicted continued rapid expansion of this service. The paper, covering the operating requirements for air cargo transportation, touches briefly on warehousing, schedules, charter flights, rates, flying equipment, personnel, and pick-up and delivery service.

In reviewing the past and discussing the future of air express and freight, Mr. C. G. Peterson (Railway Express Agency) points out that a number of diversified interests are seeking to gain their own objectives, and that many of these interests naturally conflict. A controlling factor that will decide the future of air cargo operations is profit to both the operator and user of the service. After a most complete treatment of the subject, the paper concludes that when, in any profit and loss statement that is made for an exclusive air cargo common carrier in the United States, a reasonable cost is estimated for ground expenses, selling, advertising, and general administration, the result will show that it will be less profitable to conduct an exclusive cargo operation than to continue the present arrangement used by 19 airlines for handling air express and freight.

U. S. Planes Abroad

(*Continued from page* 55)

maintaining very strict control on technical information sent out of the country; information which would willingly be given on personal contact.

PANZER-BUSTERS READY

The fighter strength of the R.A.F. is unquestionably very strong indeed and now that Spitfires and Hurricanes, powered by 100 octane Merlins, equipped with either four 20 mm. cannons or twelve .303 machine guns, are in service, fighter effectiveness has been still further increased. Early 1942 will see the inclusion of Airacobras, Lightnings and Mustangs (North American, NA-73) so that should an offensive be launched in the spring the German High Command will have to face a really formidable array of "panzer busters."

The last few months have produced a great increase in bomber strength and many new types of heavy bombers have come into use, much to Nazi discomfort. British Stirlings, Halifaxes and Manchesters—all powered by a total of more than 4,000 h.p.—have paid several destructive visits to German targets, Berlin included.

Being built up in the background, behind this bomber force are, what may be termed, the new-technique aircraft. These are made up of the American "heavies" such as the Liberator and the Fortress specially equipped for sub-stratosphere flying. Very soon these U.S. contributions will be accompanying the British types in what will prove to be the largest scale bombing offensives ever carried out.

The numbers of these ships that have arrived here is unknown and, because of the lack of operational publicity, many people are wondering why they have not been used before. No news regarding the Liberator is being released at present but the older types of Fortresses are being used to train crews and to make researches into sub-stratosphere bombing conditions. Fortresses have made several minor raids, mainly over northern French ports, and bombs have been dropped from around 35,000 ft. The Air Ministry consider these raids have been of great educational value while results, both from aircraft performance and results obtained angles, have been entirely satisfactory.

The R.A.F. are content to take this new style bombing slowly rather than risk valuable air crews and airplanes on an unknown venture. Meanwhile the training of specially selected crews with the necessary technical and medical qualifications is going ahead.

Such a policy as this can be criticized on the grounds that it is retarding the major bombing effort but it can be said that the results, when they do come, will be much greater and much more nearly 100 percent.

BOEINGS TO LIBYA

A number of the later types of Fortress have been sent to Libya where they are devastating enemy positions with great effect. The employment of these machines in the desert is interesting as their huge range is not required and it would seem that Bomber Command figure they can use a smaller number of bombers by using a type that carries a greater load. It also gives them a valuable build up of experience with this aircraft under actual fighting conditions. All this indicates that the Fortress is destined to play the leading role in future heavy bombing attacks on Germany.

The early Boeings have been criticized here over their light armament, crews saying that there is not sufficient defense equipment for a ship of its size. At the present time this seems hardly a relevant criticism because the operational ceiling is too great for existing German fighters while at these altitudes anti-aircraft fire is ineffective.

As time progresses the Nazis are bound to improve on the effective altitude of their fighters, but by that time the more heavily armed B-17E and even later versions, will be available. These, no doubt, will bristle with large calibre machine guns and shell cannon which will keep potential attackers at a safe distance.

There is little information of German sub-stratosphere developments but there can be no doubt that they are working very hard in this field. It is fortunate for the allied cause that such knowledge cannot be acquired overnight. Despite rumors of a new high ceiling fighter and Dornier bomber; also the existence, prior to the outbreak of war, of designs for a Messerschmit Me.110 incorporating a pressure cabin, it seems likely that the Germans have a long and difficult way to go before they have a type suitable for production.

British substratosphere developments are also little advertised but it seems improbable that it will be left entirely to America to supply this type to meet all allied requirements. Rather than develop entirely new airplanes for these altitudes it is a reasonable forecast that research will be carried out on such types as the Stirling, introducing it as a high altitude bomber when technical perfection has been achieved.

U. S. LEADS IN STRATO FLYING

From these remarks it can be seen that the U. S. is way ahead of other nations on substratosphere flying—a point that may well be of importance when large scale commercial flying is again resumed.

It is difficult at present to obtain any news of either British or American airplanes operating in Russia. So far the Ministry of Information has released no news of what American types, if any, have reached the Soviet. The Air Ministry has stated that some "hundreds of Hurricanes" are in the northern sector of the battle front. This is interesting in that although the Merlin motor is glycol-cooled it is doing great work in the severe Russian winter. Up to the present time it has generally been accepted that the radial was more suited to such climatic conditions and despite the non-freezing qualities of glycol it is natural to assume that American airplanes, radial equipped, would have been better suited for the Russian winter, especially in view of American experience under similar conditions.

The European winter has already been responsible for considerable curtailment in the long distance bombing program not only on account of unsuitable weather but because in some cases, equipment is inadequate to overcome the severe conditions encountered. It is probable that sub-stratosphere bombers could overcome winter storms by climbing through them and flying above them but icing troubles would still be prevalent. On a recent Berlin raid, in which by far the largest force yet sent over took part, the highest percentage of casualties over any raid was recorded. The Air Ministry stated that this loss—approximately 8 percent of the total sent—was not due to German defenses but to an unexpected weather change that was entirely unforeseen by the meteorologists. From careful inquiries it appears that these casualties were not the result of storms but to a sudden change to very severe cold which caused icing-up, not only externally but inside the cabins, affecting such things as instruments and radio.

ICING PROBLEMS

This is a very important lesson and shows the inadequacy of cabin heating in even medium altitude bombers as well as the need for improvement in the anti-icing arrangements for external parts. British heating systems are usually operated from one motor and, in most cases, are inferior to the set-up used on American aircraft. On multi-engined ships a system drawing heat from two or more engines seems necessary with the ability to cut out one or more sources of heat as necessary. As operational heights become greater this problem gets increasingly important and any improvements that can be found will be of value in post war commercial flying.

It might be supposed that the rapid development of higher powered engines would initially result in frequent failures, or at least seriously complicate repair and maintenance problems. Devastating results in the early days of 100 octane fuel can be recalled, but this problem and many others have been successfully overcome and wartime motors are amazingly trouble free even under extreme conditions.

Up to the moment the Rolls-Royce Merlin is, without doubt, the most outstanding motor of the war. This engine has been used with equal success in both bombing and fighting aircraft under conditions varying from the desert to the Russian winter. When it first appeared the Merlin was rated at around 800 hp. while the latest version, using 100 octane fuel, is probably giving something approaching double this figure.

U. S. RADIALS POPULAR

American radials, the Wasp and the Cyclone are giving a good account of themselves and are deservedly popular, though there have been difficulties, mostly caused by inadequate spares supplies. Then, too, original servicing set-ups were responsible for initial troubles which naturally caused a certain prejudice. A great many of these difficulties were due to lack of understanding of a foreign product, but instruction, technical representation and servicing facilities have greatly improved. Still further engineers are required, however, if the job is to be done really well. In this connection, American firms will be interested to hear that Maj. Gen. Brett, as a result of his observations both here and in Libya, has said that maintenance and service are one of America's biggest jobs and that American companies will have to devote a whole lot more attention to it.

The R.A.F. are doing all they can to help and are arranging for a number of their more skilled maintenance mechanics to visit U. S. plants to undergo a short but concentrated course of instruction. U. S. firms will doubtless appreciate the importance of these visitors upon whose knowledge and competence depends the reputation and prestige of their products.

Still greater power outputs from engines are continually being called for and the performance of existing aircraft will need to be bettered as the war develops. Still further increases in output are scheduled by engine builders and many people here are speculating on the announcement of 2500/3000 hp. motors from both Pratt & Whitney and Wright.

Possible future developments on en-

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gines here are obscure due to the strict secrecy control but, as a forecast, it seems reasonable to suppose that a good deal of attention is being paid to direct injection in view of German success in this direction. It would not be surprising therefore to see Bristol announce a new radial in 1942, probably an 18 cyl. with sleeve valves and having an output of around 2220/2500 h.p. While this engine would probably appear at first with normal carburation, direct injection might be incorporated later.

A great deal of interest is centered around the new Napier Sabre about which little is known except that it is a 24 cyl. liquid cooled, sleeve valve motor of H section employing twin crankshafts, two speed supercharger and using 100 octane fuel. AVIATION, in August, forecast the power output of the Sabre as being in the region of 2,000 hp. but it is most probable that this estimate is very conservative indeed and that when figures are released the power will prove to be several jumps ahead of all other motors in production.

Little has been heard of the Allison engine to the present time but early in the New Year this further U. S. contribution to freedom will, no doubt, rank as highly in reputation as its American predecessors of the last war.

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